GREAT STREETS BTV

City of Burlington
Downtown Street Design & Construction Standards
Adopted April 16, 2018

CITY OF BURLINGTON, VT

The Great Streets Initiative is a joint project of the Community & Economic Development Office, the Department of Public Works, and the Department of Planning & Zoning.

Mayor of Burlington—Miro Weinberger

Acknowledgments
The development of these standards was a collaborative effort by all City Departments involved in the design, installation and maintenance of elements within the downtown public right-of-way. Thank you to the dozens of City staff from the following departments who contributed time, knowledge and insights into the development of this document, which will guide the reconstruction of Burlington's rights-of-way for generations.

City Departments
Burlington City Arts
Burlington Electric Department
Burlington Fire Department
Burlington Parks, Recreation & Waterfront
Burlington Police Department
Church Street Marketplace
Community & Economic Development Office
Department of Planning & Zoning
Department of Public Works

Great Streets Initiative Project Management Team
Kirsten Merriman Shapiro—Senior Policy and Project Specialist, CEDO
Laura K. Wheelock, P.E.—Public Works Engineer, Burlington Department of Public Works
Meagan E. Tuttle, AICP—Comprehensive Planner, Planning and Zoning Department

Great Streets Design & Consulting Team
Suisman Urban Design
DuBois & King
Michael Vergason Landscape Architects
WagnerHodgson Landscape Architecture
Domingo Gonzalez Associates
Urban|Rain Design
Third Sector Associates
Toole Design Group

This document is best viewed in spreads using two-page view.
The Appendix should be viewed as single pages.

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I want a walkable BTV because...
Walking gives me more time to enjoy the city!

1 Great Streets for Downtown Burlington

Through many years of planning, citizens of Burlington have voiced their support for a vision of downtown as a vibrant, walkable, sustainable urban center. Great Streets BTV is about bringing this vision to life and transforming downtown's public realm over the next several decades by investing in streets that meet our community's goals.

What is a Great Street?

A GREAT STREET IS...

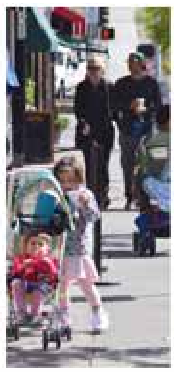
A Great Street is built to endure many decades and reflect Burlington's values—values which have been articulated in community plans such as planBTV Downtown & Waterfront, Burlington Transportation Plan, planBTV Walk/Bike and many others. According to these plans, a Great Street is truly transformative, and is:

- **WALKABLE AND BIKEABLE,** safe for all modes and levels of accessibility
- **SUSTAINABLE,** both environmentally and in long-term durability
- **VIBRANT,** to support downtown's diverse range of public and private facilities
- **FUNCTIONAL,** serving all users, flexible, maintainable and affordable

PRIVATE ◄ PUBLIC ROW ►

Burlingtonians have said they'd like to see improvements on the street and these are the zones where those improvements can happen.

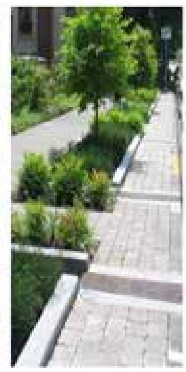
Building Frontage



Clear Sidewalks

Tree Belt/ Furnishings

Bikeways & Buffers



Stormwater/ Rain Gardens

Parking/ Roadway

Projects & Studies Informing the Great Streets Standards

Re-Imagining Burlington Town Center
Private improvements to redevelop the site, with corresponding public improvements, notably through the reopening of long-closed street segments on Pine and St. Paul

Burlington Transportation Plan
A broad policy document that supports the Great Streets philosophy, Complete Street initiatives, and improved walking, biking and transit; anticipates the new transit center on St. Paul

VAT Town Road and Bridge Standards
Establishes state standards that may apply to some segments of the downtown grid

NACTO Urban Street Design Guide
An influential national document that provides the policy support and detailed design guidance on creating urban streets that serve multiple users and purposes

Transportation Demand Management Action Plan
Offers strategies for City of Burlington to reduce automobile dependence and increase the use of transit, bikes, and walking, especially within downtown

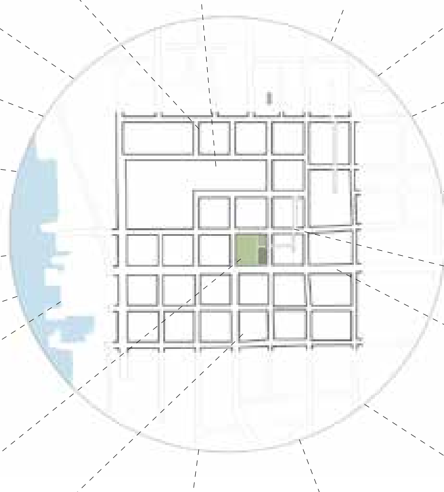
Plan BTV Walk Bike (Draft)
Provides detailed guidance on pedestrian and bike improvements that directly affect downtown streets

Complete Streets - A Guide for Vermont Communities
Establishes statewide standards and policy support, critical for the Complete Street segments in downtown

planBTV Downtown Code (Draft)
Provides a dramatically new approach to citywide zoning which supports more housing, mixed-use and transit within downtown

Burlington Street Design Guidelines
Defines and designates the street typologies for downtown: Transit, Complete, Bike, and Slow, and Pedestrian

GRAPHIC SYNTHESIS OF PREVIOUS EFFORTS AND STUDIES



planBTV Downtown & Waterfront
Extensive, long-term, citywide effort that provides the vision and direction for downtown as a livable, walkable, sustainable, transit-oriented district

College Street Stormwater Basin - Opportunities Toolkit
Provides a strong vision and range of tools for stormwater management on College that is widely applicable throughout downtown

Downtown Tax Increment Finance (TIF) Plan
Provides the basis for funding streetscape and public realm improvements, especially within downtown

Main Street Scoping Study
A current initiative looking at different roadway configurations for Main Street to accommodate all users, including bicyclists

Plan BTV Burlington Parks, Recreation & Waterfront Master Plan
Positions City Hall Park within a linked system of parks, open spaces, and waterfront; provides reference for City Hall Park and downtown waterfront park areas

Burlington Electric Department Street Light Policy
The citywide policy basis for improving the quality and efficiency of downtown street lighting within the new design and construction standards

City Hall Park Concept Design
Provides an advanced conceptual redesign of the park, with strong community input and support; critical link between College and Main

Residential Parking Plan
A plan that considers permit parking residential neighborhoods to protect them from downtown visitor overflow

Champlain College - Eagle's Landing Development Plans
A key development within downtown that will be designed and built concurrently with the improvements on St. Paul Street

Downtown Parking & Transportation Plan
A comprehensive look at on-street and off-street parking in downtown, along with associated strategies for marketing, wayfinding, and development

The Great Streets Initiative draws upon local, state and national plans and guidance, including, but not limited to these Burlington plans and studies.

Why Great Streets for Burlington?

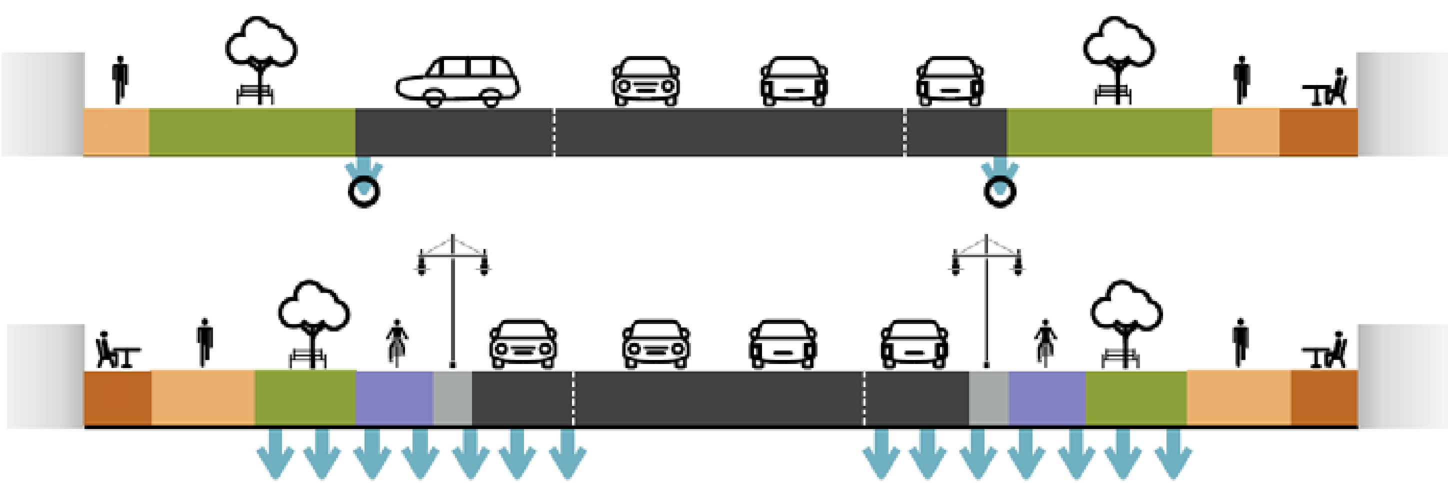
BALANCE USERS & USES

Through the Great Streets Initiative, the City of Burlington has established the goal of creating "great streets" in downtown wherever possible. Every roadway, passage, walkway, sidewalk, bumpout, and crosswalk within the right-of-way is part of downtown's public street system—which comprises 33% of all of the land in downtown Burlington. Burlington recognizes its street system not merely as roadways for vehicles, but as the backbone of its collective public space, which reflects the values, identity, and character of Burlington. A "great street" system for downtown Burlington will merge seamlessly with public parks and plazas within it, and blend harmoniously with the built environment, pathways, and open spaces on adjacent private property. Together these integrated paths and places will create the setting for a downtown that is welcoming to all, socially vibrant, environmentally sustainable, and economically prosperous.

A great street system for downtown Burlington will also restore a balance among all of the users and uses within the public realm. Throughout most of urban history, walking has been the primary form of movement on city streets. But over the past 100 years, the growing demands of the automobile for ever more space to move and to park have tended to overwhelm all other users, not least the pedestrian. Burlington intends for these standards to correct that imbalance by once again placing the needs and experience of the pedestrian first, while ensuring that all other users and uses are accommodated in a delicate balance.

These standards build upon the principles for the design and function of the public realm found in dozens of plans, studies and design guides prepared by the City, and in some cases state and national organizations. Rooted in these plans, the standards detail both the basic requirements and options for transforming this street network by:

- addressing all features of the public right-of-way, including sidewalks, buffer areas, parking and travel lanes, bicycle lanes and medians.
- supporting roadway types that address and provide safe and adequate access for all modes of travel, including people walking, biking, using transit, or driving.
- implementing complete streets, increasing the availability and utilization of sustainable transportation options, and achieving the "vision zero" principles to eliminate traffic-related fatalities and serious injuries.
- designing streets that are responsive to and encourage vehicular travel at appropriate volumes and speeds based on their surroundings in residential, commercial or mixed-use districts.
- developing a strong connection between public rights-of-way and the buildings and structures that line them.
- reducing quantity of stormwater runoff and heat island effect, and improving quality of stormwater runoff.
- providing clear, implementable design direction for projects which will, by nature, be implemented in phases over many decades.



Streets take up around 45 acres—33% of downtown land—making them an important zone for investment. Great Streets will emphasize streets as public places, and restore a balance among all users and uses within the public realm that is appropriate to the downtown context.

A VISUAL LANGUAGE THAT IS UNIFIED, NOT UNIFORM

An additional goal of these standards is to create a visual language for downtown that emphasizes the roles of both the public and private realms in communicating its character. The urban cores of most cities have a kind of visual or formal language that is expressed in the design of their streets and buildings. This language may be manifest in construction materials and colors, vegetation, furnishings, or signage. It may emerge organically, such as from tradition or economic patterns, or, it may be propelled by "standards" which specify a particular character for the public environment based on a variety of considerations.

Burlington has many aspects of its own language, which has evolved over nearly 200 years. Perhaps the most distinctive feature of downtown's language is its historic buildings, particularly the ornamented brick and stone facades of multi-story commercial structures. Overlaid on these are a more recent series of public investments, such as ornamental street lighting, decorative paving on Church, stormwater gardens, sidewalk bumpouts, and a wayfinding system with distinctive color and form.

But these characteristics are not cohesive throughout downtown, and are weakened by areas with no distinctive language. These standards are intended to create a coherent language for the streets of downtown—to help *unify* downtown without making it *uniform*. The standards provide a set of common street materials and elements that recognizably belong to Burlington, are elegant to look at and use, support environmental sustainability, and are affordable to construct and maintain.

In general, the standards are not intended to distinguish one street from another (with the exception of Church Street), or one part of downtown from another (with the exception of primarily residential blocks). Downtown is too small for such variation, and it is more costly and difficult to maintain such a variety of elements. Instead, the standards, as they are implemented, should yield a fundamentally unified public space.

Diversity and variety in the visual environment is also important; they give expression to the diverse individual and group sensibilities and interests of Burlington residents. These standards are premised on the principle that within downtown Burlington, diversity is best expressed, and should most often be provided, by the adjoining buildings, shops, signs, spaces, and furnishings on the private property which abuts the public realm. Some cities insist on uniform architecture and signage. While Burlington's zoning rules require certain underlying principles of transparency and street activation, there is a wide range of possibility for architectural expression. Questions of aesthetics and visual language are ultimately mediated by the design review bodies, which determine where projects should fall on the spectrum from conforming to eccentric. While this document is about unity in the public realm, it encourages diversity along the private edges to give full expression to the character of Burlington as a place and as a community.

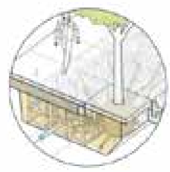
These standards will guide the reconstruction and replacement of materials and infrastructure in the public realm over the next several decades. Achieving this unified visual language will come as individual streets and blocks are rebuilt, and as infrastructure and furnishings throughout downtown reach the end of their useful life and need to be replaced. This will be a big investment, and it will not happen all at once. This incremental transformation of the public realm underscores the importance of a commitment to these common materials and elements. Without this palette, individual street segments will continue to be designed as a reflection of the era in which they were built, and will continue to pose visual and functional challenges in the cohesion and maintenance of downtown's public streets.

Burlington Street Design Guidelines

These guidelines will ensure that downtown streets are walkable, bikeable, sustainable, vibrant and functional.


Presence of windows, doors, storefronts, awnings along sidewalks


Local sources, durable, handsome


Use of soil cells or structural soils for new trees in paved areas


Major increase in trees, foliage, and shade from an approved list of species


Landmarks are recognized and featured by view corridors and special lighting


Unique installations at key locations


Special emphasis on safe and easy street crossing with wide, distinctive crosswalk treatments


Careful sidewalk design to accommodate snow plowing and storage


Efficient and updated lighting for sidewalks and roadways


Innovative handling of stormwater to slow and permeate


Investments in appropriate bikeways along key routes


More efficient on-street parking spaces, and better use of existing off-street parking facilities


Working with CCTA, integration of shelters and signage into the sidewalk landscape

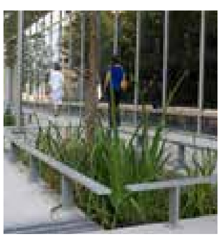

Widening and improving of sidewalks throughout downtown


Special paving and bollards for places where vehicles and pedestrians share the space


Investments in protected bike parking and bike hubs

Standard Great Streets Furnishings & Materials

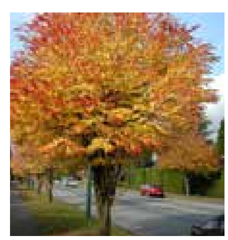
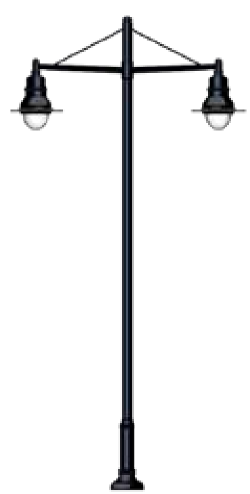
These furnishings and materials will result in Great Streets that adhere to the design guidelines.

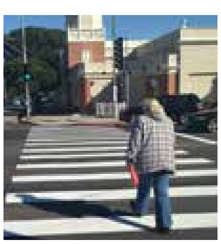



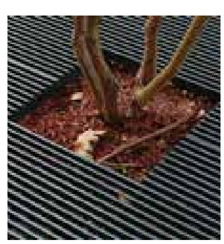











REFRAMING THE "CENTER" OF DOWNTOWN

Part of Burlington's overall vision for downtown is to reconnect Church Street, City Hall Park and the lake through a series of investments in the public and private realms. To this end, a final goal of these standards is to invest in quality materials and furnishings throughout downtown that will help spread commercial vibrancy and social activity beyond the Church Street Marketplace.

The earliest plans for Burlington show not only a chessboard of buildable blocks, but an open public square on one of the more central blocks. Such squares, often designated as the location for the main courthouse, were a common feature of new American cities with gridiron plans. Burlington's center was indeed dubbed Courthouse Square and the city's first courthouse was constructed there.

An open square within a grid tends to convey special importance on the four streets which adjoin it, which form a kind of pinwheel. In downtown Burlington, College, Main, St. Paul, and Church Streets have greater prominence due to their adjacency to the square. These four streets bordering the square were the primary commercial addresses during the city's early decades. The square was a relatively utilitarian space, with roadways, places to hitch horses, and a relatively small oval lawn in the center. The open design of the square exposed the adjoining buildings on all sides except the east, where civic buildings were erected between the square and Church Street.

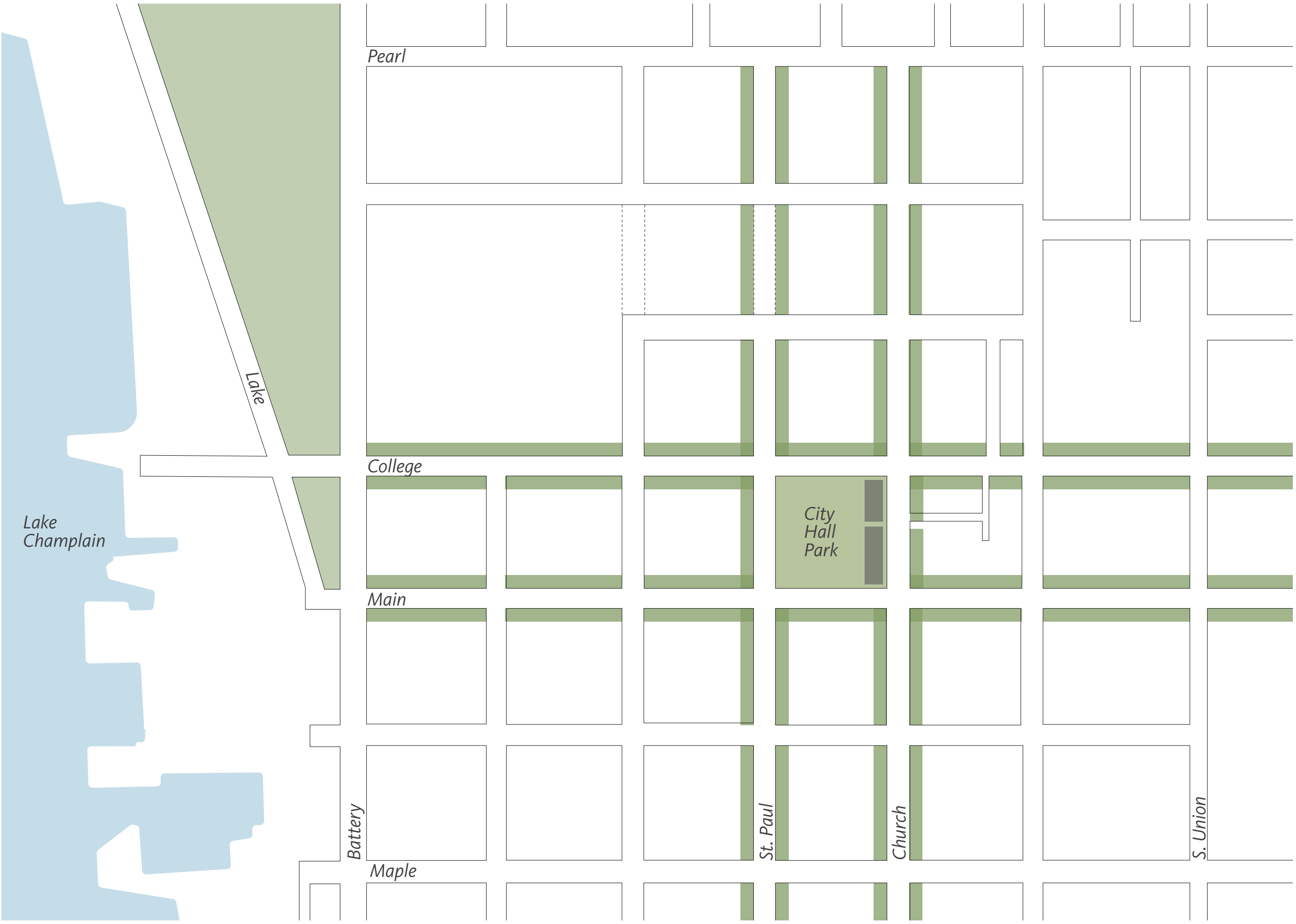
As the urban park movement took hold in the 1850s, Courthouse Square was redesigned as an ornamental park for strolling, sitting and leisure—this became an early iteration of what we now know as City Hall Park. The introduction of trees and landscaping had the effect of separating the sides of the square. In a somewhat unusual and awkward relationship, the civic buildings had their primary facades and entrances on Church Street, all but leaving their backs to the face the park.

During a period of commercial expansion in the 1880s, more and more businesses migrated away from the streets around the park, relocating instead to Church Street. Church eventually became the de facto "main street," meeting the key criteria for a traditional American main street: it was nearly level and lined with nearly continuous building storefronts and doorways, factors which are essential for commercial activity. Church Street's prominence was cemented in the 1980s with the banning of vehicular traffic and the creation of Church Street Marketplace. The street's success has been key to the revitalization of downtown Burlington in the ensuing three decades.

By contrast, both City Hall Park and its surrounding commercial streets have experienced ups and downs since the early days of Courthouse Square. The park has been redesigned several times, and has recently benefited from the arrival of the Saturday farmers market during the summer and fall. During that event and others, the park (and to some extent the surrounding streets) reclaims its role as the most central and vibrant location in downtown. But at other times the square can seem relatively empty and inactive, particularly in comparison to Church Street. These two versions of the park—one as the bustling center of activity and the other as an empty space in poor condition—have simultaneously led to its degradation through overuse, as well as to its isolation and chronic challenges with behavior and petty crime.

With Church Street and City Hall Park at its core, these standards will guide public investments in surrounding streets that will improve the quality and connectivity of downtown as a whole. While there has not been an explicit master plan guiding these investments, decades of improvements to the Church Street Marketplace, the recent reconstruction of blocks of lower Church and St. Paul Streets, additional plans for St. Paul Street approved in two separate approvals by Burlington voters, the stormwater plan for College Street, and the Bike/Walk plan's vision for infrastructure for walking and biking on Main Street are all key to achieving this goal. These improvements envision urban activity radiating around City Hall Park along two pairs of streets in particular—St. Paul and Church, and College and Main—and further activating downtown as a whole.

The Pinwheel



The Pinwheel: Prioritizing the implementation of the Great Streets Standards on College, Main, St. Paul, and lower Church Streets will recenter downtown around City Hall Park, and strengthen the connections between downtown and Lake Champlain.

Photo credit Don Shall— https://flic.kr/p/c3B8bG

Using this Document

How to Use this Document

This document should be consulted at the early stages of project development, and used throughout the design process, to ensure unity in the redevelopment of downtown streets.

Start Here:

Review Design Considerations for Project Development

Consult *"Design Considerations for Project Development" on page 18* to understand current and future land uses, transportation, utility and other factors that affect the project within the downtown context, and then consult *"Design Considerations for Street Corridors" on page 34* for specific factors which influence the design of the street corridor and the specific project within it.

Identify Proposed Street Type

After reading about the design influences for the particular street corridor, locate the Proposed Street Type in the street's chart of Character/Uses within *"Design Considerations for Street Corridors" on page 34*.

Select Roadway & Pedestrian Zone Options

Flip to the corresponding Street Type in *"Roadway & Pedestrian Zone Options" on page 66*. Identify the most appropriate options for the project's roadway and pedestrian realm based on the street's design considerations and results of any other planning or scoping studies.

Apply Standard Zone Dimensions

Once the preferred options for the pedestrian and roadway zones have been determined, review all of the pertinent standards for dimension, location, etc of these elements according to *"Standard Dimensions & Siting Considerations" on page 96.* Consult *"Bikeways" on page 139* for additional requirements regarding the incorporation of bicycle facilities.

Consult Street & Intersection Assemblies

Utilize *"Street & Intersection Assemblies" on page 80* to guide the selection and placement of appropriate furnishings for midblock and intersection locations, and verify that they meet any required siting considerations found in *"Standard Dimensions & Siting Considerations" on page 96*.

When the required standard dimensions do not allow for the placement of an element in the preferred location, consult *"Public Placemaking" on page 119* section for guidance on alternative arrangements for some of these elements.

Select Streetscape Elements

Utilize *"Street Ecology" on page 171* to select the appropriate street tree species and tree belt conditions for the street context, and to identify options for green stormwater infrastructure. Apply the street lighting standards from *"Lighting" on page 245* to the design.

Finally, use the *"Materials & Furnishings Palette" on page 269* to select specific streetscape elements and furnishings needed to prepare cost estimates and other specification documents.

Click on the green links to navigate directly to the correponding section of this document.

Utilize *"Glossary & References" on page 320* **for key terms and links to other plans and projects that may need to be consulted in project development.**

Who Should Use This Document

These standards will guide the design and construction of projects within the public right-of-way, and will be used by anyone involved with transforming streets in downtown Burlington. This includes:

- Planners or project managers responsible for projects within the public right-of-way, such as city officials and staff from departments such as Public Works, Parks & Recreation, Community & Economic Development, Planning & Zoning, Police, Fire, and Electric, as well as outside entities, such transit and private utility providers who operate in the public right-of-way
- Professional street designers who are working on projects within the downtown right-of-way, including urban designers, landscape architects, civil engineers, transportation planners and engineers, lighting and utility designers, public art consultants and designers, environmental systems designers, etc.
- People who experience these streets, who will benefit from a downtown public realm that is developed over decades utilizing consistent design priorities.

These Standards DO:

- Identify a common palette of materials and furnishings that will provide for unity and visual integrity as downtown's streets are redeveloped over time
- Complement Church Street's beloved visual character and high level of investment, without replicating it wholesale throughout downtown
- Create a public realm that is complementary of current and future private development, and which showcase building facades, signage, etc as the unique and authentic aesthetic elements of downtown
- Draw upon city and state standards regarding the design and construction of the right-of-way as applicable, and includes all critical required elements/ dimensions in a comprehensive document
- Include preferred and alternative materials/fixtures for elements within the public right of way to allow flexibility to adapt to unique street conditions, project budgets, or other constraints
- Take precedence over existing City policies/documents regarding the design and construction of elements within the public right-of-way that existed prior to the most recent date of adoption by Council (unless otherwise noted)

These Standards DO NOT:

- Mandate the immediate reconstruction of all streets or replacement of individual elements within the ROW; instead, the standards should be applied to streets as they are redeveloped in a significant way, and guide the replacement of furnishings when they reach the end of useful life
- Provide specific designs for each street in downtown Burlington; some streets will require corridor-specific master plans to identify future design/transportation system goals
- Inventory all conditions that may exist within the City's public rights-of-way, particularly unknown conditions such as locations of abandoned utilities, contaminated soils, etc.

Applicability

These standards apply to all projects within the downtown, except the Church Street Marketplace, when the project area includes an entire block face or more. The downtown is defined as all streets between and inclusive of Pearl to Maple, Union to Battery, and Lake Street. These standards should be consulted as the starting point for any construction project within the downtown rights-of-way. Designers should work with the City to fully incorporate recommended Street Types utilizing the preferred dimension for Roadway and Pedestrian Zones.

Relief from Standards

It is expected that full compliance with these standards is the starting point in all project design. In some cases, utility relocation, accessibility into adjacent property, transportation requirements, cost, or other unique constraints may prevent the complete redevelopment of the street and/or full compliance with these standards. Where conflicts or extenuating circumstances prevent the application of one or more standards, the City Engineer may grant relief on a case-by-case basis based on the context of the project.

Pilot Materials & Elements

Throughout these standards, some materials, elements, or treatments have been identified as "PILOT." These elements have been selected due to their adherance to the principles discussed in this section. However, in some cases, these elements may utilize emerging technology and/or materials which will require their limited application and field testing before being fully integrated into these standards. Designers should work with the City Engineer and/or applicable City Departments during early stages of project development to establish guidelines for pilot elements, including installation procedures, length of time to field test, how to evaluate performance, and how to define a successful pilot.

Amendments & Updates

These sa tandards are applicable as of the date of adoption or update listed on the cover. A history of approvals and amendments is provided in *"Adoption & Amendments" on page 323*. Following City Council's initial adoption, individual elements shall be updated as needed by the action of the applicable appointed board, commission, or department, per the authorities deligated in the City Charter, Code of Ordinances, and any supplemental resolutions and/or adopted policies.

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1877 birds eye view of Burlington.

2 Burlington's Downtown Streets

Design Considerations for Project Development

This section provides foundational information regarding the existing and future downtown conditions that will influence the design of projects, including land uses, transportation network, utilities, and other factors.

The Boundaries of Downtown

For the purposes of these standards, the downtown is defined as a 6 × 6 block grid bounded by Pearl and Maple Streets to the north and south, and Battery and Union Streets to the west and east.

Because of downtown's varied terrain and organic development, its apparent boundaries have shifted over time. While Battery on the West and Pearl on the North have remained clear edges, to the south and east the boundary has slowly expanded into parts of the adjacent residential districts. On the south, most of Main Street was a clear edge until commercial activity spread further south to King and Maple to take advantage of flat waterfront frontage. On the east, Winooski formed a sharp boundary due to the ravine; but as bridges were built and the ravine was eventually filled in, the downtown core gradually expanded eastward towards Union as important links developed uphill to the institutions.

If the geometry of the downtown grid were a perfect 6 × 6 checkerboard, this would create 84 individual street segments. However, over time some short street segments (such as Center) were added, and other street segments (such as Bank, St. Paul and Pine) were removed during redevelopment in the 1970s, leaving approximately 82 individual street segments, including the planned restoration of a block segment on each St. Paul and Pine Streets between Cherry and Bank Streets.

Since many street design projects affect only a single street segment, or a small group of segments, these standards are likely to be applied over an extended period of time on a large number of individual construction projects. The standards are intended to be strong enough to create a discernible visual integrity to downtown's public space, but flexible enough to allow for change over time, as individual projects are realized. Furthermore, these standards apply to all streets throughout the downtown except for Church Street; their application may be further limited or modified as noted in the design considerations for each individual corridor.

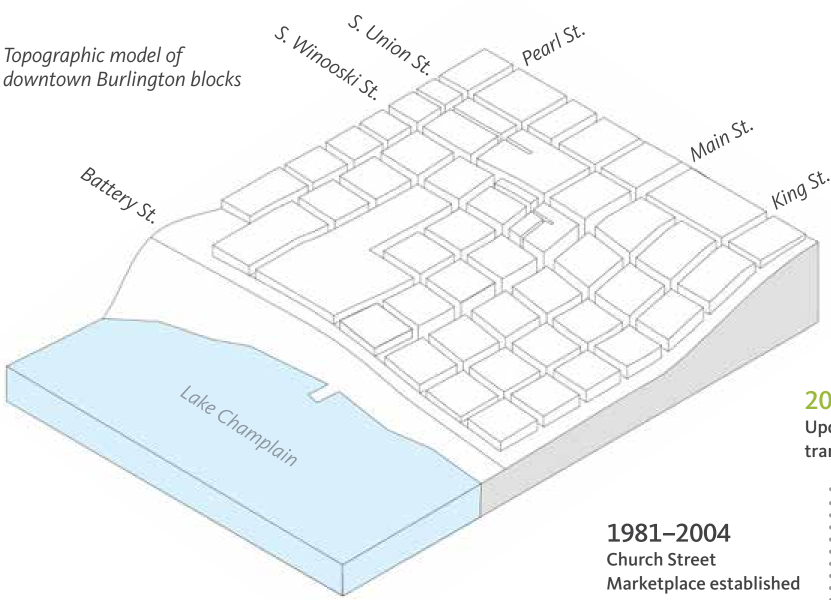
Existing Conditions

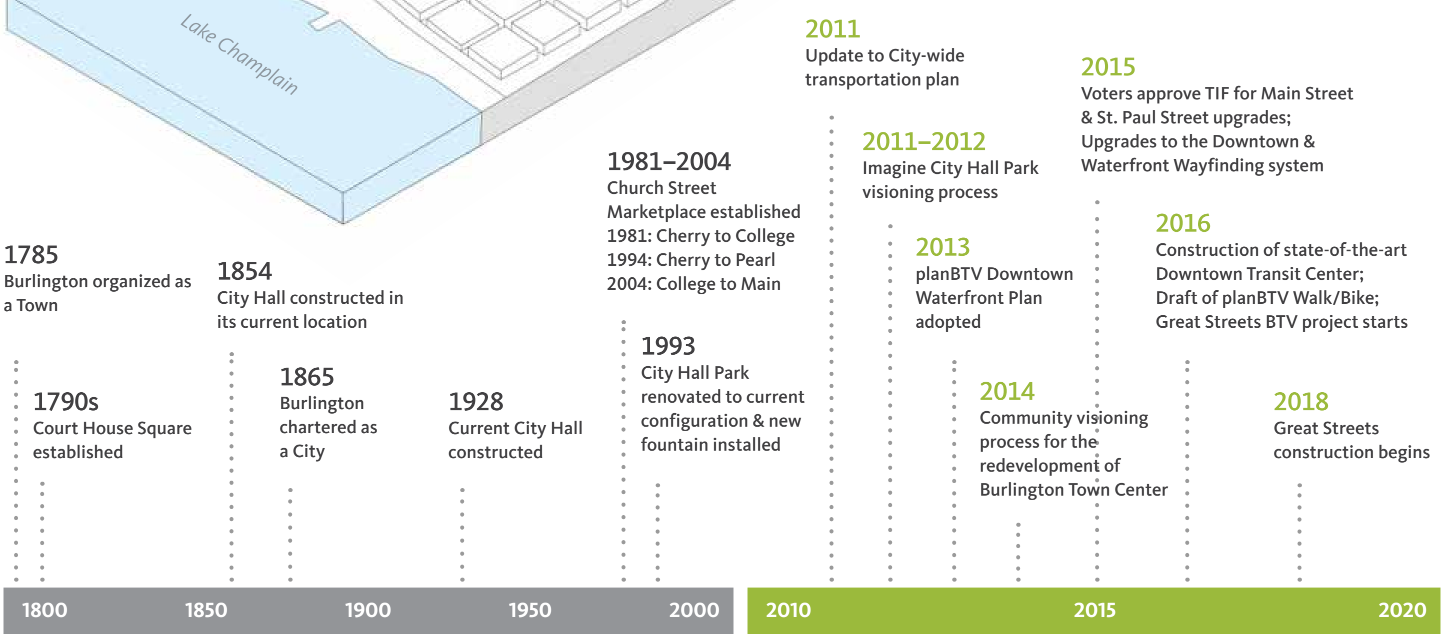
HISTORIC GRID ON SLOPING TERRAIN

The original street layout for Burlington dates back roughly to 1785. At its core, the layout was comprised of regular square blocks, 400' × 400', arranged in a checkerboard pattern. By 1830, the downtown core was built out to a 5-block by 6-block grid. Though the regularity of the design suggests that it was laid on flat terrain, the downtown actually slopes significantly to the southwest, at approximately 45 degrees to the grid. Historically, the 30-block grid was missing 3 blocks at the southeast corner where the Winooski Ravine precluded building, another indication of the complex terrain, and 7 blocks are missing today as a result of the demolition and subsequent redevelopment of the northwestern portion of the downtown during Urban Renewal.

While the two-dimensional layout suggests regularity, the terrain creates significant variety in the character of the streets, which have varying slopes, sometimes even within a single block. This variable sloping impacts views, human and vehicular movement, drainage, architectural design, and retail frontage. Furthermore, the long history of Burlington's built environment means that there are decades of public and private investments that have occurred within the space now dedicated to the public right-of-way. As a result, there are many situations in which private structures and relics of antiquated utility systems encroach into the public right-of-way—both above and below ground—and are not necessarily accounted for. The variations create both opportunities and challenges for those designing individual street blocks or entire corridors. Existing and proposed conditions relating to many of these characteristics as they're known today are outlined in the sections that follow.

Topographic model of downtown Burlington blocks

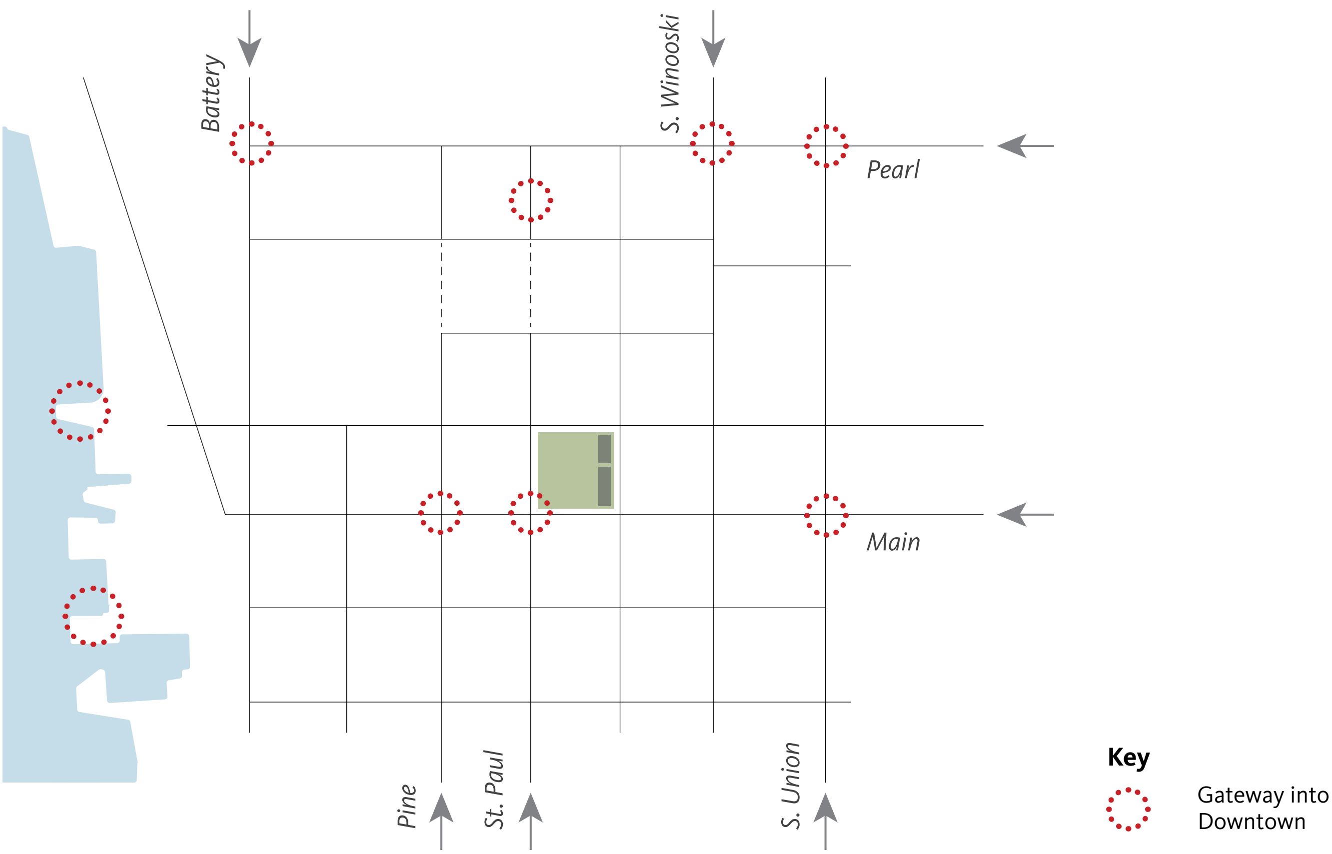




Throughout its history, the City has made significant investments in downtown and the public realm. In recent years, residents have provided significant input on the next generation of investment in downtown.

GATEWAYS

There are multiple gateways into downtown. However, due to the current configuration of streets leading into downtown, gateway points are somewhat irregular in their location while the streets themselves define a clear perimeter around the downtown core. Nevertheless, gateways, including those on the waterfront, are opportunities for the design of the public right-of-way to welcome visitors to downtown. They are transition points and possible key locations for wayfinding information in the public right of way.



Gateway Streets and Gateway Points in downtown Burlington via all modes of transportation.

ON-STREET PARKING

The *Downtown Parking Management Plan* provides detailed recommendations for comprehensive on-street and off-street parking management aimed at more efficient utilization and better financial performance, with an overall goal of expanding access to downtown via all modes of transportation. Included in the recommendations is reconfiguration of the types and rates of on-street parking for specific streets.

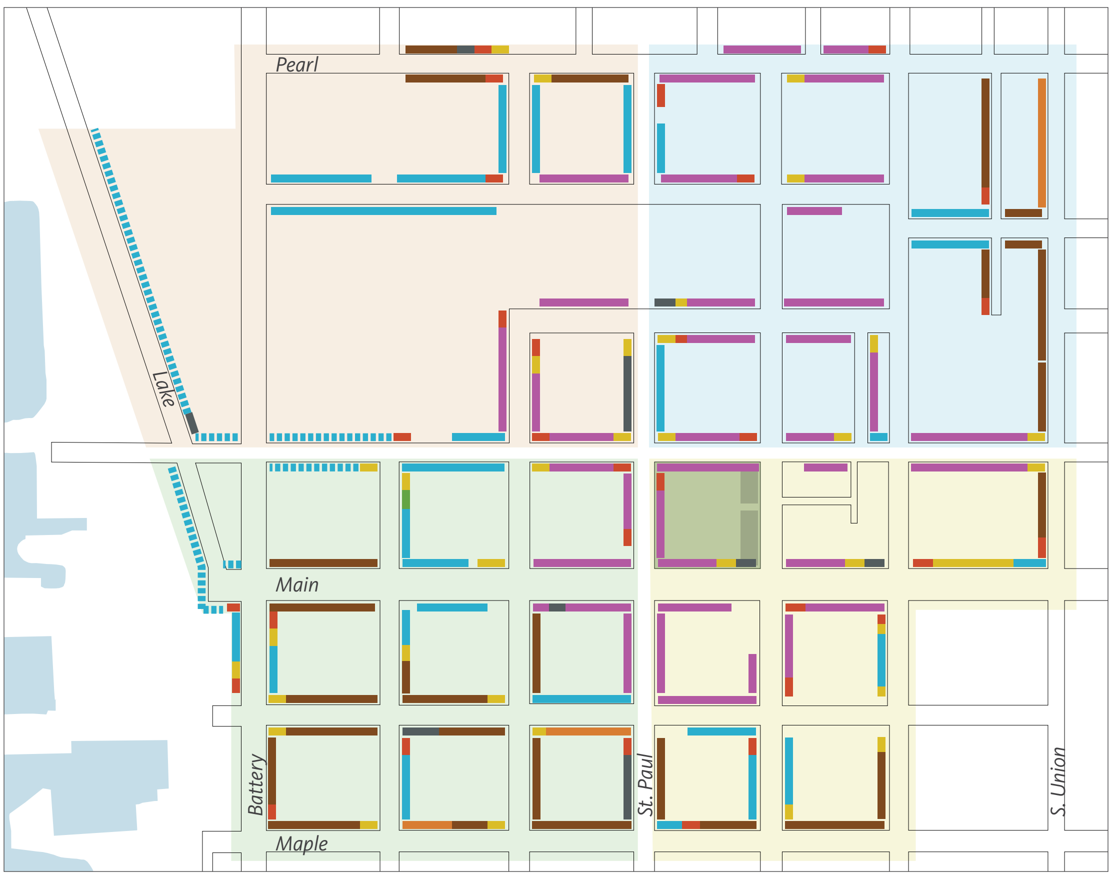
The maps of existing and proposed parking scenarios come from the Downtown Parking Management Plan. As street reconstruction projects are implemented, these recommendations may be revisited and/or modified. When considring street parking scenarios for Great Streets projects, consult most recent version of the plan for any updates to the recommended parking system.

Existing On-Street Parking

Existing On-Street Parking Type				Meter Zones	
yellow	Short Term (15–30 min.) *	red	Handicapped	tan	1
blue	Medium Term Meters (1–3 hrs.)	gray	Other	light blue	2
brown	Long Term Meters (10 hrs.)	green	Unrestricted	light green	3
purple	Smart Meters (no time limit)	orange	Residential Permit	light yellow	4

**These spaces may be metered or time limited up to 30 minutes.*

Proposed On-Street Parking



Proposed On-Street Parking Type				**Meter Zones**	
	Tier 1 Meters (30 min.)		Tier 4 Meters (10 hrs.)		1
	Tier 2 Meters (no time limit)		Handicapped		2
	Tier 3 Meters (3 hrs.)		Other		3
	Tier 3 (seasonal) *		Residential Permit		4

** Seasonal meters operate as Tier 3 from May 1 to October 31, and as Tier 4 from Nov. 1 to April 30.*

STREET TREES & TREE BELTS

There is a large gap in Burlington's tree canopy in the densest part of downtown, where tighter sidewalk conditions are less favorable to tree growth. While the area surrounding Burlington is lush and green, canopy coverage is severely limited downtown in areas of high pedestrian activity and where overhead or underground utility locations pose a challenge.

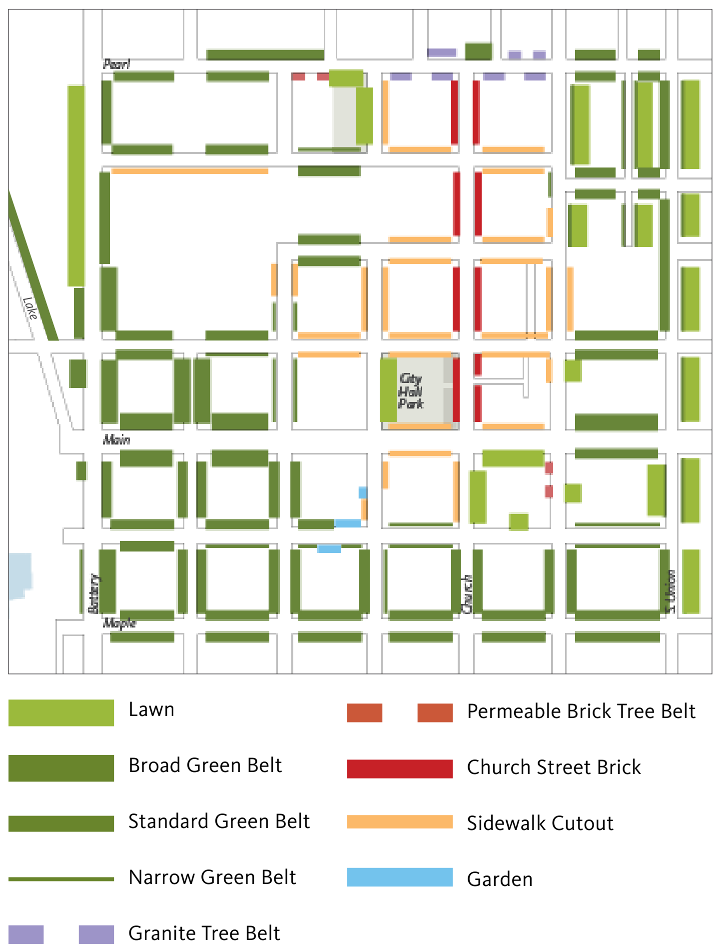
Handling stormwater and producing healthy street trees are interrelated goals. The leaf canopy of large trees can hold and slow rainfall. On the ground, the treatment of the tree belt is critical to avoid erosion and to slow water flow. Existing green belts are subject to trampling, erosion, and unmitigated stormwater runoff. The current downtown 4' × 4' street tree grates are not ideal for supporting long term tree growth. Though they protect against compaction, they require maintenance and are subject to frost-heaving.

Currently, Burlington's downtown street trees are exist within a mosaic of tree belt conditions, many of which are not successfully supporting trees to maturity. Under the sustained intensity of Burlington's urban pedestrian traffic and winter snow clearing strategies, the downtown street tree canopy is caught in a cycle of planting and replacing young trees that don't have a chance to mature.

Two methods of street tree planting are currently under-performing in their ability to grow mature trees: sidewalk cutout planters and standard tree belts lined with turf. Great Streets BTV's calls for the complete replacement of sidewalk cutout planters and the targeted reduction of turf-covered tree belts, especially in areas of high pedestrian traffic.

While the area surrounding Burlington is lush and green, canopy coverage is severely limited downtown in areas of high pedestrian activity.

Existing Tree Belt & Green Belt Zone Conditions



Existing Conditions

Sidewalk Cutout

Streets: Bank, Cherry, Church, College, Main, Pine, St. Paul, S. Winooski

Sidewalk cutouts are the most common street tree planting condition on streets with high pedestrian activity. Typically, Sidewalk Cutouts are a 4'x4' opening in the concrete sidewalk with a tree planted in the center. Few of these have healthy and mature trees in them. Several host dead trees or are empty, while others present trip hazards. Where iron tree grates have been provided to protect soils, larger trees sometimes heave grates or grow into them. Without organic planting soils under the surrounding pavement, or the ability for soils to exchange air and water with the atmosphere, most trees can't survive in them for many years. Only Honey Locusts and a few Elms are surviving in these conditions and growing up to moderate size.

Standard Green Belt (width: 5'–10')

Streets: Bank, Battery, Buell, Champlain, Cherry, Church, College, King, Maple, Pearl, Pine, St Paul, S Winooski

Established in the 2011 Transportation Plan's Street Design Guidelines, the minimum tree belt width is 5'. In the downtown area, standard green belts between 5'–10' in width, typically planted with turf, are the most common existing street-tree planting condition. Where pedestrian activity is high and slopes are steep, soils in these green belts are often compacted and eroded, while in residential areas these green belts support some of the streetscape's largest trees. This is especially true where open lawns are present on the back side of the sidewalk. Where tree roots can reach under sidewalks to larger soil volumes, they can support larger canopies.

Lawn

Streets: Battery, Main, Pearl, S. Winooski, St. Paul, S. Union

Trees on private land function as part of the streetscape on several blocks in Burlington. Large, open soil volumes support trees which survive to produce large canopies. For example, on Pearl, Main and S. Winooski, large trees in lawns shelter sidewalks with tree belts that are too narrow to support similarly-sized trees. Where this condition exists, it is a vital component of Burlington's urban canopy.

Broad Green Belt (width: >10')

Streets: Battery, Champlain, Main

Broad green belts host trees planted along some of the busiest streets and widest sidewalk setbacks in Burlington. Trees in these green belts are planted in turf; sometimes this turf is healthy, but frequently, it is compacted and eroding. Similar to standard green belts, turf isnt a successful furface material for maintaining tree health or managing stormwater runoff for areas with steep slopes and/or high pedestrian activity.

Narrow Green Belt (width: <5')

Streets: Battery, Cherry, College, King, Orchard Terrace, Pearl, Pine, S. Union, S. Winooski

Narrow Treebelts are remnant spaces left between sidewalks and street edges. In some downtown locations, these can support trees. Where Narrow Treebelts are the slimmest, they can often only support only turf. In some residential areas, Narrow Treebelts support trees because open lawns with soil volumes are available across a narrow sidewalk. Narrow Treebelts are an acceptable condition only in residential areas with low foot traffic.

Granite Tree Belt

Streets: Pearl

Granite cobbles line the treebelt in lieu of turf. Roots and soils are protected from compaction by the cobble paving and steel/iron tree grates or crushed grael. Some trees in this condition are surrounded by vertical black-painted steel tree guards. Structured soils or horticultural soils in Silva Cells extend beneath concrete sidewalk to achieve required soil volume. This pavement type does not function as a permeable surface. Joints quickly become filled with compacted dust and debris.

Permeable Brick Tree Belt

Streets: S. Winooski, Pearl

Permeable brick pavers line the tree belt in lieu of turf. Roots and soils are protected from compaction by the brick paving and iron tree grates. Trees in this condition are surrounded by vertical, black-painted-steel tree guards. Permeable brick covers uncompacted horticultural soils in Silva Cells. Because soils are not exposed, erosion in this condition is limited. The brick-covered tree belt is a useful space for pedestrian overflow and streetscape furnishings, although tree grates can occasionally become a trip hazard.

Church Street Brick

Streets: Church and adjacent segments of Bank, Cherry, and College

A unique tree planting condition is utilized along Church Street, which is designed for high pedestrian activity. Two sub-conditions are present. On Church Street, circular metal grates cover the sidewalk and vertical tree guards protect trunks. On adjacent streets, an open-centered cone of granite cobbles surround the street tree trunk. Nearly all of the trees in the Church Street planters are Honey Locusts—an extremely urban tolerant tree. Where tree grates and cobbles are present, they occasionally become a trip hazard.

Garden

Streets: King & St. Paul

Two areas of garden-like street-tree planting exist on King and St. Paul streets. Adjacent to a new building or within the standard treebelt area, trees have been planted in groundcovers other than turf for aesthetic affect and erosion control.

STORMWATER

Reducing phosphorus from Lake Champlain and ensuring the continued capacity of the City's main wastewater treatment plant are serious issues that must be accounted for as the City grows and is redeveloped. Today, most of the stormwater runoff from streets, parking lots, and buildings within the downtown area is quickly conveyed via underground pipes to either Lake Champlain or the City's wastewater treatment plant. There is a great need to change this current engineering practice to a more sustainable approach that improves water quality in Lake Champlain and also relieves some of the burden on the City's combined sewer system. This newer approach, called green infrastructure, manages runoff closer to the source, on the surface, and within landscape or pervious paving systems and mimics the natural hydrology of Burlington before urbanization occurred. Using landscape systems such as rain gardens, stormwater planters, and trees, stormwater runoff can be captured and disbursed into the ground before it reaches the stormwater system or a waterbody. A downtown green infrastructure network creates a series of decentralized, shallow, and widespread landscape-based stormwater facilities used to capture, slow, cleanse, and potentially infiltrate runoff. Because downtown Burlington has a mixture of street types ranging from slow-speed residential to high-speed arterial streets, the "toolkit" described later in this plan (*page 216*) has stormwater strategies that fit in a variety of street typologies.

Many of downtown Burlington's streets have landscaped spaces that can be retrofitted with green infrastructure or have underutilized asphalt space that can be converted to landscape space designed to capture stormwater runoff. Capitalizing on existing space that is currently inefficiently designed is a vital step in creating a green infrastructure system. Employing a robust urban tree canopy is equally important.

Trees are an undervalued green infrastructure system along highly urban downtown streets. Perhaps it is because the growing conditions are so challenging for street trees to reach maturity. Trees, considered the "lungs" of our landscape, should also be considered our umbrella for stormwater management. Achieving a healthy canopy of street trees has many stormwater benefits, including capturing and evapotranspiring rainfall from branches and leaves before the rainfall even hits the ground. In addition, trees also slow rainfall as it moves down the branching pattern and trunk of the tree, and finally absorbs runoff within its root system.

Utilizing small scale landscape-based and hardscape stormwater systems not only helps downtown Burlington improve it's economic, social, and environmental conditions, but it is also a cost-effective way to prepare for the effects of climate change. Increasing amounts, duration, and intensity of rainfall due to climate change is a reality for Vermont. Planning and building natural and inter-connected stormwater management facilities during the next few decades will help as a first line of defense against changing climate. Because it is anticipated that rainfall intensities are expected to increase, design approaches should change accordingly to better adapt to these conditions.

The decentralized stormwater approach for downtown Burlington spreads shallow stormwater facilities throughout the entire streetscape as much as possible, thereby capturing runoff before it becomes too concentrated and heavy in volume. The decentralized approach would allow for much greater plant diversity, and integration of stormwater management into other streetscape amenities. Multiple smaller facilities placed along a street to capture runoff more evenly before volume and concentrations become too intense during strong storm events. This approach is important because installations of single rain gardens, or grassy tree belts that become compacted and eroded have proven to be insufficient to handle current runoff, and will become increasingly incapable of accomodating stormwater.

Above and right: downtown Burlington topography and stormwater flow from northeast to southwest.

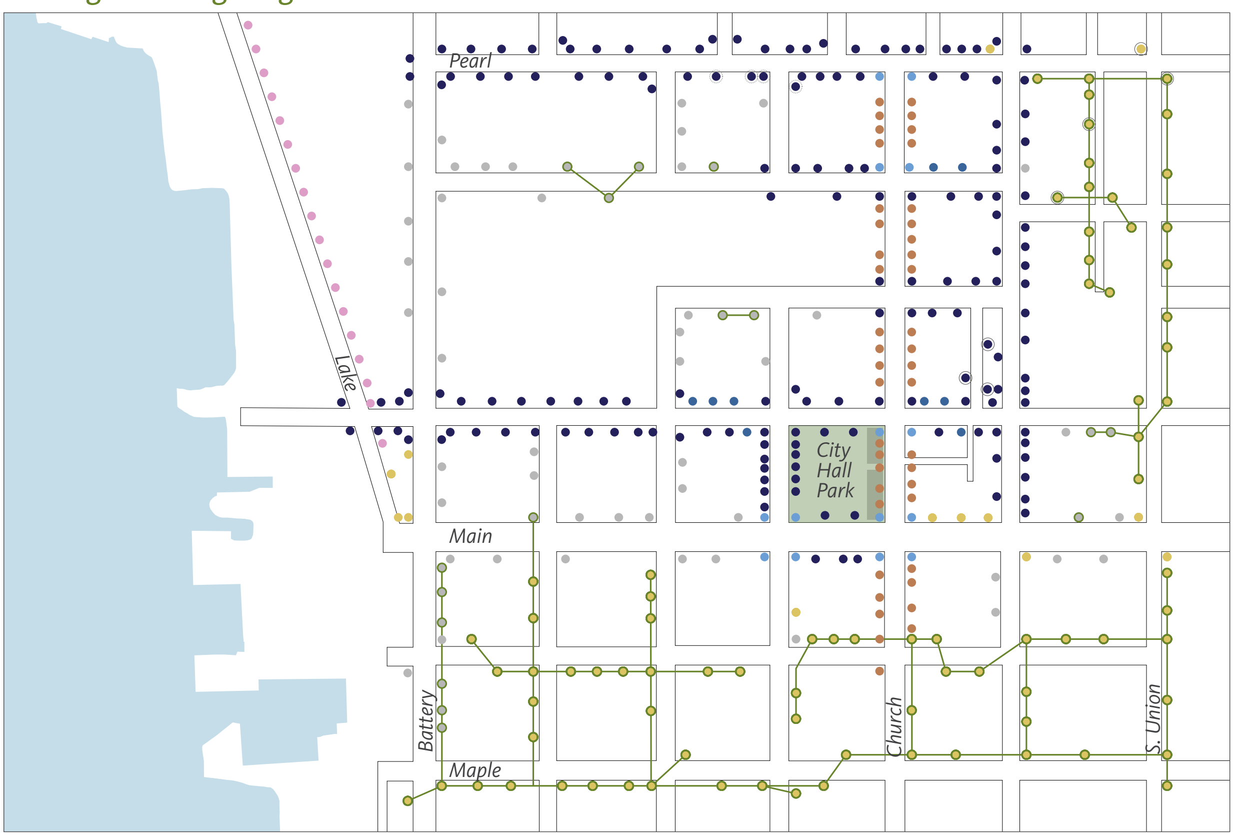
STREET LIGHTING

The downtown street lighting system serves many purposes, providing for visibility that promotes pedestrian and traffic safety, illuminates pedestrians in areas where they leave the sidewalk and could conflict with vehicles, and illuminates areas of importance-- all of which must be done while adhering to dark skies principles.

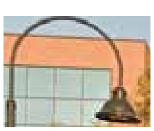
The existing street lighting inventory in downtown Burlington consists of a range of pole types (steel, aluminum, concrete, and fiberglass) at varied heights and inconsistent spacing with cobrahead, dome-like, and teardrop type luminaires (both LED & HID). Burlington Electric Department's (BED) existing concrete poles are systematically being phased out and replaced by fiberglass poles. Most luminaires are LED, with the exception of high pressure sodium (HPS) cobrahead luminaires still prevalent along King, Maple, and S. Union Streets. BED's current practice is to replace the HPS luminaires at end of life with LED cobrahead luminaires. At least half of the existing lighting ensembles currently utilize the Philips "Domus" full-cutoff 4000K cool-white LED luminaire on a custom gooseneck arm mounted to a round steel pole.

With the top of the gooseneck arm approximately 30 feet above ground, this configuration raises questions about the appropriateness of scale to the character of downtown Burlington. As with most full-cutoff area LED luminaires, when the luminaire is energized, high-angle glare from the light source can be observed. Based on typical existing condition lighting calculations, in most cases the street lighting can afford to be dimmed or reduced while still meeting recommended IES RP-08 light levels.

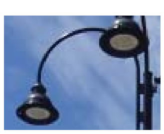
Existing Street Lighting Conditions



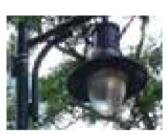
Domus 50 (single, tall) LED



Domus 50 (single, short) LED



Domus 50 (double) LED



Renaissance 20 LED

Lake St. Fixture

Cobra-head HPS

Cobra-head fixture LED

Overhead power

PUBLIC ART

Art is an integral part of the fabric of a city. It helps tell the story of the city, creates a unique sense of place, contributes to neighborhood vitality and stimulates new economic activity. The Art in Public Places program supports the development of art in the public realm that is creative, well-crafted and integrated into the physical, cultural and historical context.

Public artwork in downtown should strive to:

- Contribute to a more vibrant and memorable public space for residents, workers, and visitors.
- Create a sense of place.
- Encourage exploration of the City and promote public education opportunities.
- Celebrate the city's diversity and promote people-friendly places.
- Range from monumental scale to intimate streetscape elements.

Within the public streetscape, there are many opportunities for public art: parklets, plazas, interactive features, stand alone sculptures, and other installations. Standard public works elements like sidewalks, crosswalks, catch basins, vents, manhole covers, and traffic utility boxes, and functional elements such as benches, bike racks, and information kiosks all can be customized. While these standards present a palatte of "typical" elements that should be utilized in the public realm, many of these elements can become art. In the case of a unique, custom element, these standards provide guidance on the required dimensions, performance criteria, and placement which elements must meet. It is critical that all public art have a maintenance plan and schedule before installation.

While outside the purview of these standards, art should be encouraged in private development. This helps connect the public and private realms, and adheres to the Great Streets principle that private frontages are the unique and authentic expression of Burlington's character. Blank walls (if unavoidable) are opportunities for art, as are empty storefronts which can be utilized for temporary art installations to enliven the streetscape.


1 Amphibians


2 Unfailing Dialogue

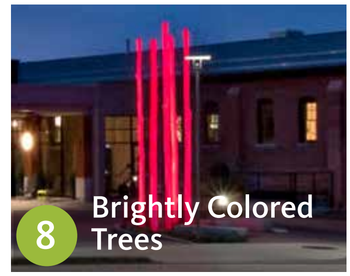

3 Gen. William Wells


4 Sculpture in the Community


5 Foundations


6 The Winged Monkeys


7 Silver School


8 Brightly Colored Trees


9 Hummingbird


10 Queen City Crown


11 Millennium Sculpture


12 Threshold


13 Leap Froggers


14 Bear Fountain


14 Deer Fountain


15 Katster Lock


16 Incognito


17 Everyone Loves a Parade!


18 Democracy


19 Kryptonite Lock


20 Three Children


21 Kiss #2


22 Archways

These images represent a sample of public art in downtown Burlington based on the Burlington City Arts Art in Public Places website and inventory, as it existed in December 2017.

Future Influences

FUTURE PEDESTRIAN & BICYCLE FACILITIES

PlanBTV Walk Bike envisions a fully connected bicycle network that appeals to people of all ages and abilities. In total, the plan adds new bikeway types to the city's streets, including protected bikeways, neighborhood greenways, advisory bike lanes, and bicycle priority lanes, also known as "super sharrows." More details on future bicycle facilities and plans can be found in the Plan BTV Walk Bike Master Plan. Information on the proposed bike facilities has been integrated into the design considerations for each street corridor in the sections that follow.

15-Year Bikeway Network Plan—planBTV Walk Bike Master Plan

PRIORITY INTERSECTIONS FOR SAFETY UPGRADES

The information in this chart has been taken from the planBTV Walk Bike Master Plan.

Location	Key Problems	Ideas to Consider	Next Steps
Bank & S. Winooski	Conflicts at driveway crossings (City Market and Simons gas station); vehicle speed and lighting also factors	Reduce speeds thru lane reassignment; Land use/urban design/access changes to reduce driveway crossing distances and conflicts.	Corridor Study planned; demos/pilots of curb extensions and lane reassignment while study is developed
College & S. Winooski	Turning traffic failing to yield to pedestrians in crosswalk; lighting; speed also factors	Mini-roundabout; reduce crossing distance and/or speeds with curb extensions	Corridor Study; demos/pilots of curb extensions and lane reassignment while study is developed
Main & S. Winooski	Turning traffic failing to yield to pedestrians in crosswalk; long crossing distance and speed also factor	Advance or exclusive pedestrian phase; roundabout; reduce crossing distance and/or speeds with curb extensions	Great Streets initiative; Corridor Study; demos/pilots of curb extensions while design is developed
Main & St. Paul	Turning traffic failing to yield to pedestrians in crosswalk; long crossing distance and speed also factor	Roundabout; reduce crossing distance and/or speeds with curb extensions	Great Streets Initiative (Downtown TIF project); demos/pilots of curb extensions while design is developed
Pearl & N. Winooski	Southbound left turn traffic fails to yield to pedestrians in crosswalk on Pearl.	Exclusive or advance pedestrian phase; Curb extensions to reduce speeds and crossing distance, and enhance visibility	Corridor Study; demos/pilots while study is developed
Cherry & S. Winooski	Turning or side street traffic failing to yield to pedestrians in crosswalk	Curb extensions across Cherry to increase visibility and reduce crossing distance; roundabout; advanced pedestrian phase	Corridor Study; demos of curb extensions while study is developed
Maple & Battery	Lack of pedestrian signals; Turning traffic failing to yield to pedestrians in crosswalk	Reduce distances with curb extensions; exclusive pedestrian phase	Pedestrian signals, upgraded curb ramps/sidewalk access improvements to be installed.

CITY'S OFFICIAL MAP

Connecting to the waterfront remains an important priority for Burlington's downtown. Many of the existing east/west streets feel cut off from the lakefront. Connections to the water's edge, whether they are visual or physical should be strengthened. For more details on the the proposed streets, public ways, public parks and other public lands and visual corridors shown on this official City map (Figure 1), reference the City's Zoning Ordinance (Section 4.2.2 and Map 4.2.2-1 Downtown & Waterfront Core Official Map).

Figure 1: *Downtown & Waterfront Core Official Map—Burlington Zoning Ordinance*

RETAIL FRONTAGE

Active frontage (shops, restaurants, cafés, historic sites, cultural venues, etc.) is primarily concentrated along and parallel to the Church Street corridor, with only intermittent frontage along many of the other downtown streets--particularly along Main Street. The making of a great street is not only dependent on the quality of the public realm, but also the success and liveliness of private storefronts and buildings that face that public realm. The streets standards outlined in this document along with the guidance outlined in *planBTV Downtown Code* (Figure 2) are intended to promote an active and intentional relationship between the public and the private realm. More information on the "Shopfront Frontage Required" designated streets can be found in section 14.5.13 of the code.

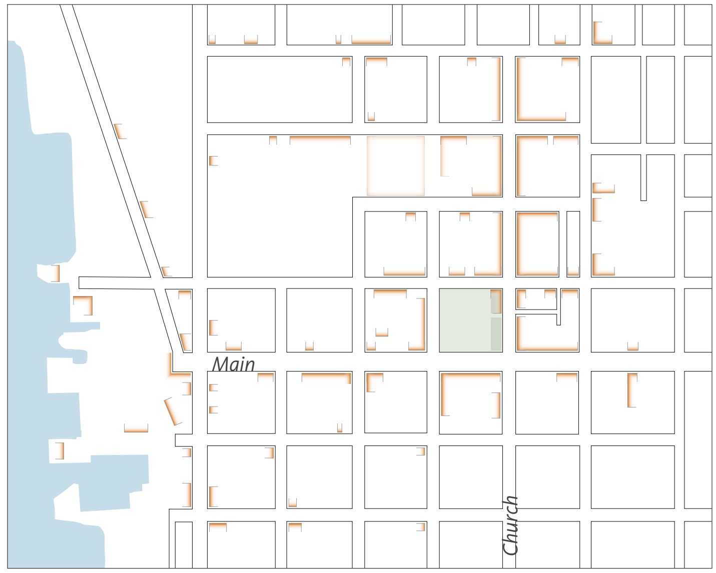


Diagram of existing active frontage space

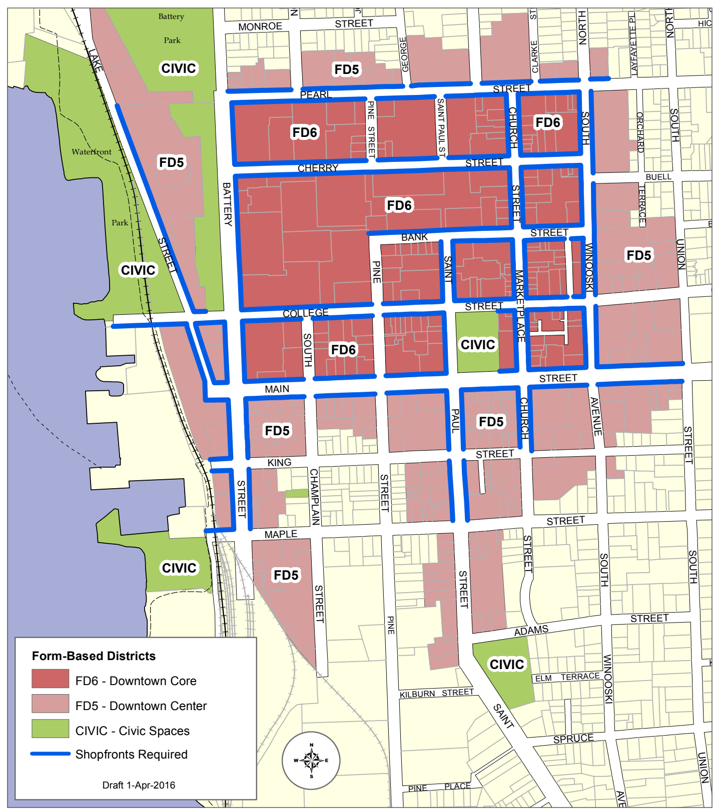
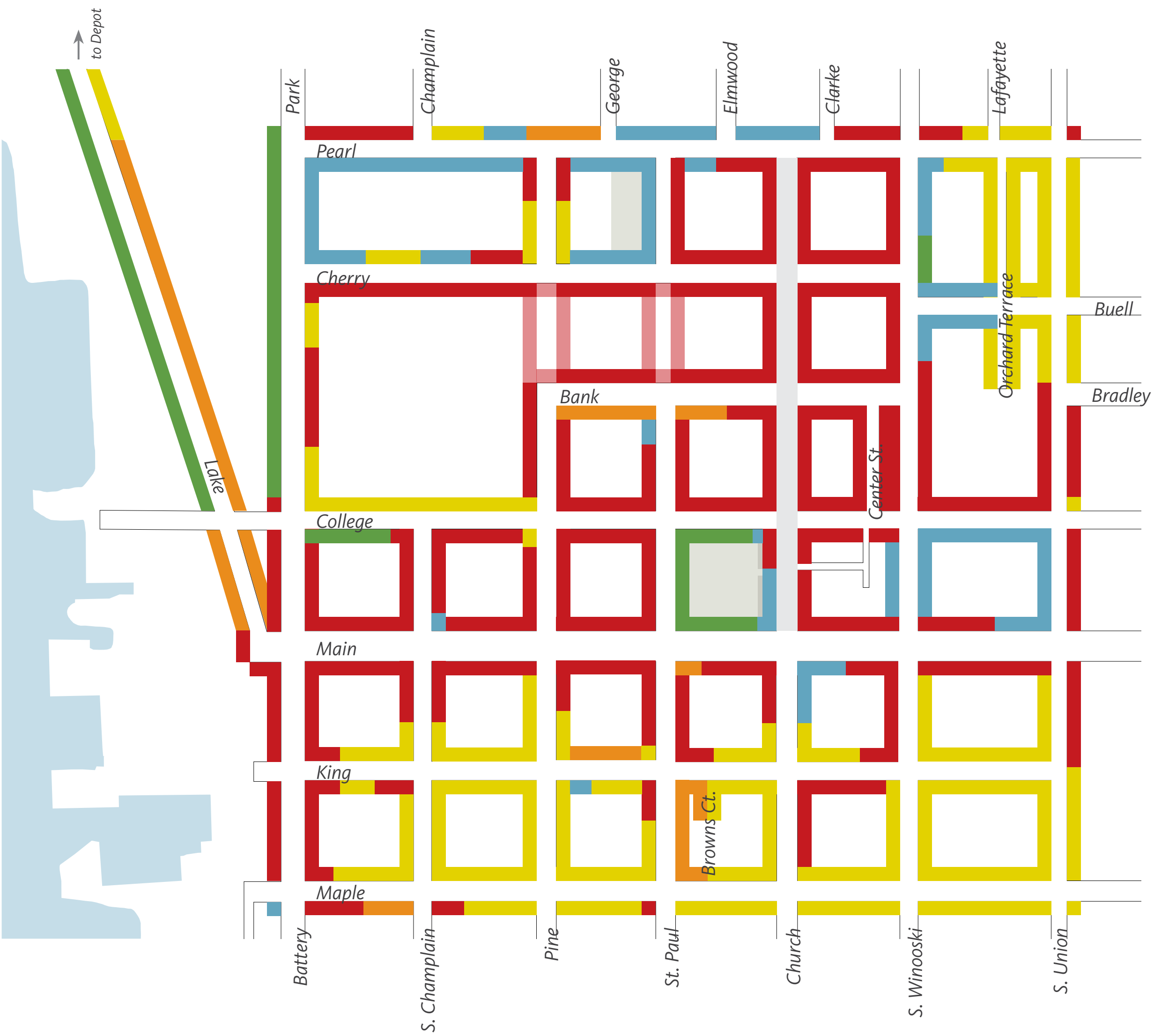


Figure 2: *Map 3 Shopfront Required—planBTV: Downtown Code*

Design Considerations for Street Corridors

This section provides additional information regarding existing and future conditions that will influence the design of street corridors and individual projects within them.

Downtown Burlington Street Frontages by Land Use



Commercial

Civic/ Institutional

Residential

Open Space/Park

Mixed Use

Primary East–West Streets

PEARL ST.

Pearl Street is a major historic connector and thoroughfare. It provided the original link from Winooski Falls to the shores of Lake Champlain. Today it functions as an important northern boundary for downtown and northern terminus of Church Street. It is an important connector between downtown, the Old North End neighborhood, the institutions on the hill, the City of Winooski, and terminates at Battery Park overlooking the waterfront. It is highly varied in its land uses, character and scale.

The corridor carries a significant number of bus lines and transit stops (including regional and interstate bus stops) as it is one of the east–west streets that frames the new transit center. The corridor currently features on-street parking, while in some sections there is parking only on one side. The planBTV Walk/Bike plan indicates that this portion of Pearl Street should feature a protected bike facility. The City is currently planning for the corridor to be realigned to have single travel lanes, parking closer to Battery Park, bike lanes in each direction (either buffered or regular), and curb extensions for crossing Pearl Street. The intersection at Pearl and Battery will also be narrowed due to the elimination of one of the right-turn-only lanes from Battery onto Pearl.

Design Considerations

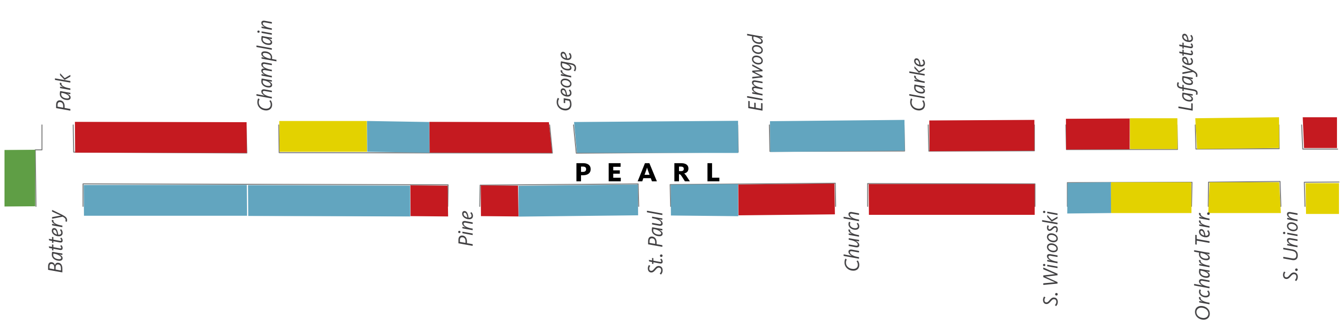
With only a 66' ROW, an offset grid on its north and south sides, many curb cuts and driveways, and few street trees, future designs for Pearl Street will be challenged to meet the many transportation priorities that have been identified for it. Opportunities for expanding its ROW may need to be considered in order to create a successful balance of users.

Existing Character/Uses

Urban Regional Linkages	Major historic connector from Lake Champlain to Colchester and Winooski
Terminus within Downtown	West: Battery Park
Terrain	Gently sloped
High Point/Low Point	High: 239' @ Union Low: 211' @ Battery
Views	To Battery Park and Adirondacks; (preserved as a "visual corridor" on the City's Official Map)
Length	2610'
Number of Blocks	North side: 7 South side: 6
Intersecting Streets	13
Intersections	11 total: 2 cross, 8 "T", 1 offset
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class II
Bus Service	Yes
Utilities & Lighting	Underground utilities & ornamental light poles, except b/w S. Winooski–S. Union
Water Systems	Combined Sewer System Potential for sandier, stormwater friendly soils west of St. Paul or Pine Streets

Recommendations

Proposed Bike Facility	Protected Bike Lane
Recommended Street Type	*"Major Commercial Street (66' ROW, 38' Roadway)" on page 74*



CHERRY ST.

Cherry Street lies entirely within downtown, is only 5 blocks long. It terminates at Battery Park overlooking Lake Champlain and at the First Congregational Church on Winooski Avenue. Its north side is mixed with residential uses, state office buildings and religious institutions, while the south side is almost continuously commercial. The southern side of the street includes a 4-block long section with no intersections, and very few building frontages activating the street as a result of urban renewal activities in the 1970s.

The Burlington City Place property is anticipated to be redeveloped to include retail frontages and reestablish the street segments of St. Paul and Pine between Bank and Cherry. Along with the site's redevelopment, the City plans to reinvest in the streetscape for the four blocks between Battery and Church, based on the 2014 PIAP.

Design Considerations

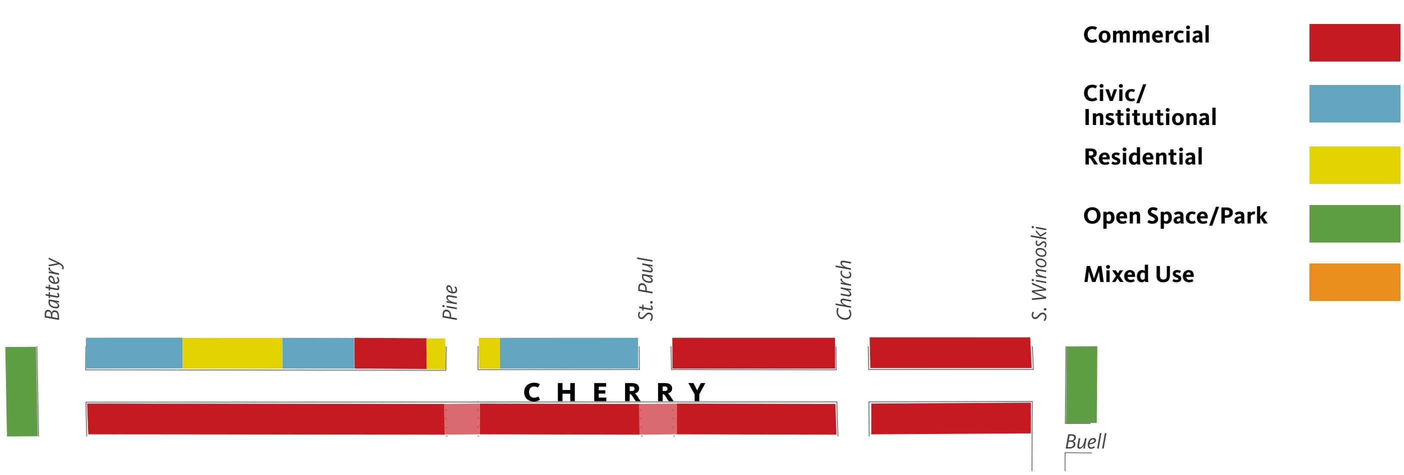
The corridor carries a significant number of bus lines and transit stops as it is one of the east–west streets that frames the new transit center. While only a 66' ROW, traffic counts are relatively low, giving it good potential for walking, biking, and placemaking improvements. The intersection with Battery Street should be an important consideration in future designs for this street, as pedestrian connections to the waterfront have been contemplated in this location, which could be realized if private property on Lake Street below Battery Park is redeveloped. In planning for streetscape improvements in this corridor, designers should be mindful of shadows cast by recent and future redevelopment along the south side of the street.

Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	West: Battery Park East: First Congregational Church
Terrain	Gently sloped
High Point/Low Point	High: 226' @ Union Low: 186' @ Battery
Views	To Battery Park and lake
Length	2105'
Number of Blocks	North side: 4 South side: 2 (4 blocks with redevelopment of BCP)
Intersecting Streets	5
Intersections	5 total: 3 cross, 2 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	Yes
Utilities & Lighting	Underground utilities & ornamental light poles, except b/w Battery–St. Paul
Water Systems	On combined sewer system, but has a separate storm and sanitary line available for connections. Possible sandy soils west of St. Paul, more likely west of Pine.

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	*"Commercial Slow Street with Transit (66' ROW, 36' Roadway)" on page 70*



BANK ST.

Bank Street is a short street that is somewhat isolated in the center of downtown due to 1970s urban renewal activities. It is almost entirely commercial, with one entire block occupied by the Burlington City Place (BCP). Small storefronts immediately adjacent to Church Street, and a number of older, formerly residential structures that have been converted to commercial/ mixed-use and provide strong character on some portions of the street. However, other blocks are lined by parking garages and inactive commercial frontages.Presently, several of the tallest buildings in downtown Burlington are located on Bank Street near the terminus of St. Paul and Pine Street.

Design Considerations

While the street currently experiences little through traffic, the redevelopment of the private Burlington City Place site is likely to transform this corridor, particularly with the reopening of portions of St. Paul and Pine Streets between Bank and Cherry. In the future, it is likely that there will be additional vehicular activity as a result of Bank Street being reintegrated into the downtown transportation grid, and the location of one of the entrances to the redeveloped property. Public improvements to two blocks of Bank Street associated with the redevelopment of the site will emphasize a vibrant and safe pedestrian streetscape and stormwater improvements.

Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	West: People's United Bank East: City Market
Terrain	Gently sloped
High Point/Low Point	High: 224' @ Winooski Low: 202' @ Pine
Views	none
Length	1275'
Number of Blocks	North: 2 (3 proposed) South: 3
Intersecting Streets	4
Intersections	5 total: 2 (4 proposed) cross, 3 (1 proposed) "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities b/w Pine–St. Paul; underground utilities b/w St. Paul–Winooski. Ornamental light poles b/w Church–Winooski
Water Systems	West of St. Paul: part of the college street separate stormwater system. East of St. Paul: on the combined sewer. Soil conditions are unknown for infiltration.

Recommendations

Proposed Bike Facility	Shared Use Lane Markings with Traffic Calming
Recommended Street Type	*"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68*

COLLEGE ST.

College Street is one of downtown's most important signature streets and is an important parallel and alternative route to Main Street for vehicles, transit, and bicycles. College Street connects UVM to the waterfront, adjoins City Hall Park, marks perhaps the most intensely used intersection of the Church Street Marketplace, and offers views of Lake Champlain from St. Paul westward. It is primarily commercial with some residential, civic and cultural uses.

Design Considerations

The City Hall Park "pinwheel concept" treats Main and College Streets as an important parallel pair. Designers should, in applying the standards, look for ways to emphasize this distinct relationship particularly through improvements that appeal to pedestrians, enhance downtown's stormwater management infrastructure, and ensure a high level of investment in signage and other street furnishings, as well as "turn-key" street light poles that can accommodate banners and special holiday lighting.

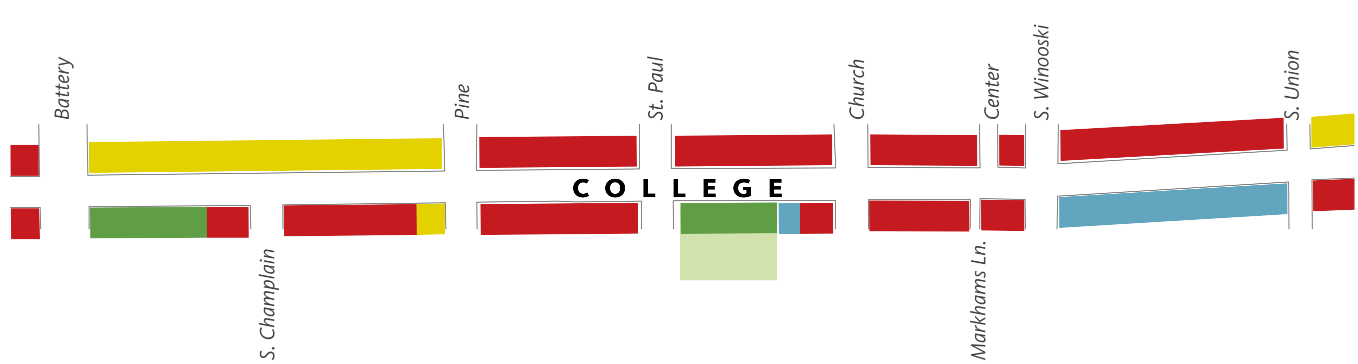
As a 66' ROW, College Street remains an intimately scaled street, while still serving an important role in the vehicular and bus networks within downtown. planBTV Walk/Bike calls for College Street to be a secondary east–west bike route to Main Street, due to its steepness and narrow width, with shared-lane markings indicated as a long-term plan for the street. College Street has a separate storm system west of St. Paul Street; the College Street Stormwater Plan identifies further green infrastructure priorities for this corridor, which should be consulted in coordination with these standards.

Existing Character/Uses

Urban Regional Linkages	East terminus at UVM campus
Terminus within Downtown	West: Lakefront/Boathouse
Terrain	Steeply to gently sloped
High Point/Low Point	High: 209' @ Church/Winooski Low: 137' @ Battery
Views	Lake and mountains to the west, Old Mill uphill to east
Length	2630'
Number of Blocks	North: 5 South: 6
Intersecting Streets	7 (9)
Intersections	8 total
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	Yes
Utilities & Lighting	Underground utilities, except b/w Winooski–Union. Ornamental light poles, except b/w Winooski–Union.
Water Systems	Separate storm system west of St. Paul, to the east, combined. Sandy soils west of S. Champlain, and possibly west of Pine.

Recommendations

Proposed Bike Facility	Shared Use Lane Marking with Traffic Calming
Recommended Street Type	*"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68*



MAIN ST.

Main Street is a gateway and vital artery for downtown and all of Burlington. It connects points east of Burlington to UVM and Champlain College campuses, downtown and to the terminus at Union Station on the waterfront, which is anticipated to once again host passenger rail service. Main Street also connects many important civic and cultural resources in downtown, including Memorial Auditorium (for which a public process will determine future opportunities), the southern terminus of the Church Street Marketplace, City Hall and City Hall Park, Flynn Theater, County Courthouse, the Visitors Bureau, and many retailers and other destinations. In addition to the reconstruction of Main Street itself, several of these key destinations will be revitalized, including City Hall Park and Memorial Auditorium/Gateway Block.

Design Considerations

At 99' of Right of Way, Main Street is among the widest streets in downtown Burlington, and given its role in the downtown network, one with the greatest potential for accommodating all modes of transportation, placemaking, amenities and services that our community has indicated are important in the public realm. Today, the corridor carries significant bus, truck and automobile traffic, and 50–75% of the right of way is utilized by cars for just two travel lanes and on-street parking.

A master plan is being developed for the Main Street corridor from Battery to Union which acknowledges the street's special character within downtown. This plan recommends the conversion of diagonal parking to parallel parking on the corridor to allow for a more equitable balance of space for all modes of transportation and to improve tree health and stormwater management. Through planBTV Walk/Bike, Main Street was identified as the community's highest priority for a protected bike lane.

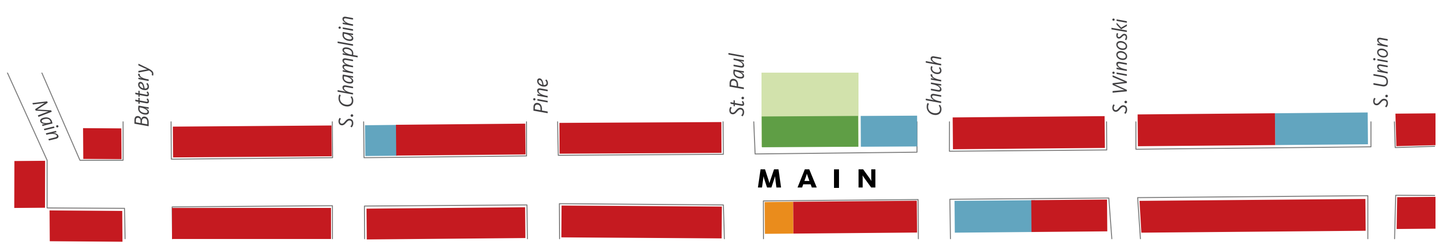
The City Hall Park "pinwheel concept" treats Main and College Streets as an important parallel pair. Designers should, in applying the standards, look for ways to emphasize this distinct relationship particularly through improvements that appeal to pedestrians, enhance downtown's stormwater management infrastructure, and ensure a high level of investment in signage and other street furnishings, as well as "turn-key" street light poles that can accommodate banners and special holiday lighting.

Existing Character/Uses

Urban Regional Linkages	Major historic connector from lakefront to UVM and all points east
Terminus within Downtown	West: Union Station
Terrain	Steeply to gently sloped
High Point/Low Point	High: 207' @ Union Low: 125' @ Battery Mid: 192' @ Winooski
Views	Lake and mountains
Length	2630'
Number of Blocks	North: 6 South: 6
Intersecting Streets	7
Intersections	7 total: 6 cross, 1 "T"
Prevailing ROW	99'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class II
Bus Service	Yes
Utilities & Lighting	Underground utilities. Ornamental light poles b/w St. Paul–Church
Water Systems	Combined sewer length of corridor. Possible sandy soils west of Pine and maybe further up the hill to the East

Recommendations

Proposed Bike Facility	Protected Bike Lane
Recommended Street Type	*"Special Commercial Street (99' ROW, 38' Roadway)" on page 76*



KING ST.

King Street has a primarily residential character, with urban multi-family infill housing developments and the King Street Center as recent additions to the character of the street. Additional infill is underway at the corner of St. Paul and King, with the Eagle's Landing project. There are pockets of commercial activity throughout this 6-block corridor, particularly near the terminus of Battery Street and the Ferry Dock/Perkins Pier on the waterfront.

Design Considerations

While costly and challenging, the overhead wires should be buried, and the wooden poles and cobrahead lights should be replaced with pedestrian-scale lighting as significant reinvestments along King Street are made in the future. King street will provide an excellent example of how the standards are applied to primarily residential streets within the downtown core.

Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	West: King Street Dock East: Private home
Terrain	Gently sloped
High Point/Low Point	High: 212' @ Union Low: 120 @ Battery
Views	Lake and mountain views to the west from the last block; terminal view east of historic home
Length	2620'
Number of Blocks	North: 6 South: 6
Intersecting Streets	7
Intersections	7 total: 7 cross
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	Yes
Utilities & Lighting	Overhead utilities b/w Battery–Union. No ornamental light poles.
Water Systems	On combined sewer; infiltrator system near intersection of Battery Street

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	West of Church Street: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68* East of Church Street: *"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72*

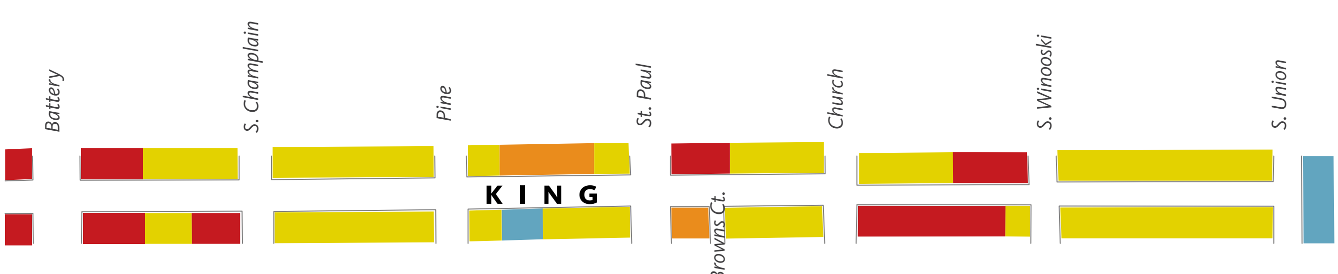
Commercial

Civic/ Institutional

Residential

Open Space/Park

Mixed Use



MAPLE ST.

Maple Street, a primarily residential street, is the southern boundary of the downtown area, particularly for the purpose of the Great Streets standards. It is an important east–west connection between the waterfront at Perkins Pier and UVM and Champlain College up the hill. While primarily residential, the street experiences heavy traffic due to the section west of Pine Street used as a cut-through to access Battery Street, and because the corridor is a parallel and alternative route between downtown and the campuses. New urban, multi-family infill development is underway at the Champlain College Eagle's Landing development at the corner of Maple and St. Paul.

Like King Street, Maple has a 66' ROW, with overhead wires, wooden poles, and cobra head lights. This infrastructure presents a challenge in terms of cost of replacement. The tree canopy is well developed on the side of the street without utility lines.

Design Considerations

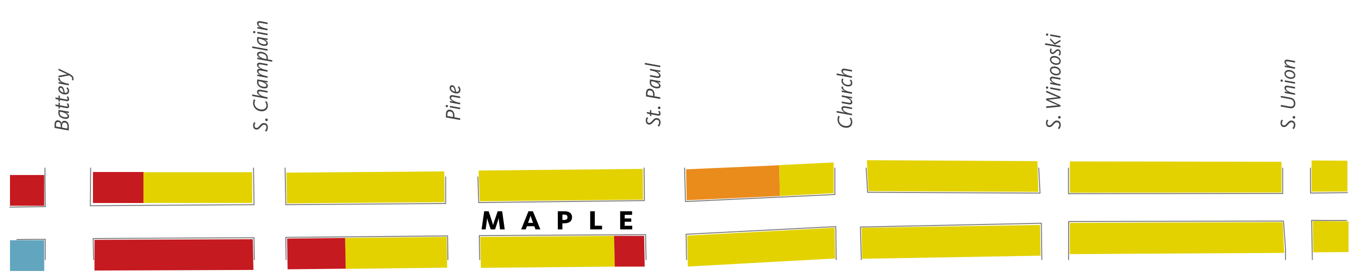
While burial of the overhead utilities may be a long-term strategy if the street is comprehensively redeveloped, it is not the highest priority for utility upgrades. Absent a full redevelopment of the street, BED should investigate whether retrofit options could be available to allow decorative fixtures on wooden poles in order to allow lighting upgrades consistent with these standards. PlanBTV Walk/Bike indicates the long-term bike facility for this street should include shared-lane markings.

Existing Character/Uses

Urban Regional Linkages	East: connects to UVM campus
Terminus within Downtown	West: Lakefront/Roundhouse Pk.
Terrain	Sloped
High Point/Low Point	High: 228 @ Union Low: 110' @ Battery
Views	Lake and mountains to the west when traveling downhill from points along the corridor
Length	2630'
Number of Blocks	North: 6 South: 6
Intersecting Streets	7
Intersections	7 total: 7 cross
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities. No ornamental light poles
Water Systems	Combined sewer system. Soil conditions unknown

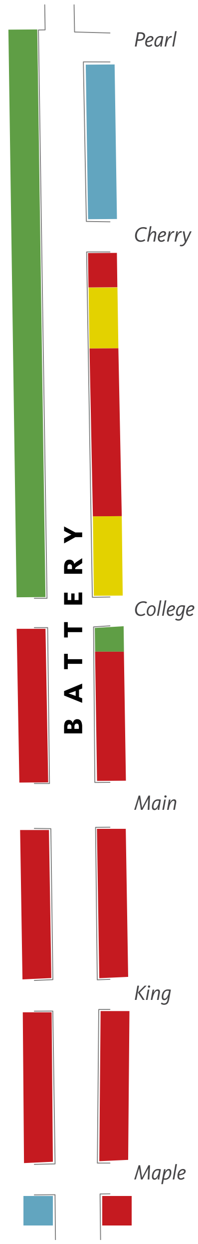
Recommendations

Proposed Bike Facility	Shared Use Lane Markings with Traffic Calming
Recommended Street Type	*"Downtown Residential Street (66' ROW, 30' Roadway)" on page 78*



Primary North–South Streets

BATTERY ST.



Battery Street is one of only three streets in downtown with a 99' right of way, and it serves a unique role within downtown. It functions as the edge between downtown and the waterfront, and the height and architectural style of the buildings along its eastern edge vary widely. From many points along the corridor, particularly from adjacent Battery Park, one can catch a glimpse of Lake Champlain and Adirondacks; however, its width and high volume of traffic can cause it to be perceived as an impediment for pedestrians and bicycles. In contrast, the two southern blocks, from Main to Maple, are exceptionally appealing blocks for walking and could be for biking with some improvements. This is due to parking on both sides, slower traffic speeds on a flatter terrain, and exceptionally attractive historic architectural character on its edges.

Design Considerations

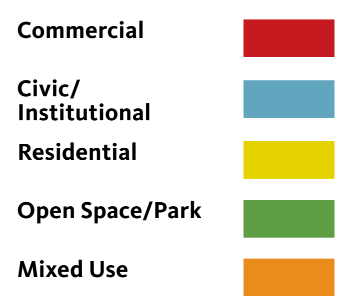
Expansion of Battery Street south through the rail yard to Pine Street is being studied, and Battery Street between College and King Streets have the potential to become important connections from the terminus of Main Street at Union Station to the waterfront, particularly for bike and pedestrian connectivity. While many of the elements of the standards can be applied here, a corridor plan is recommended for Battery due to its special considerations.

Existing Character/Uses

Urban Regional Linkages	Major historic connector to Old North End and points north
Terminus within Downtown	South: rail yards
Terrain	Sloped to gently sloped
High Point/Low Point	High: 212' @ Pearl Low: 110' @ Maple
Views	Lateral views to lake
Length	2560'
Number of Blocks	West: 4 East: 5
Intersecting Streets	6
Intersections	6 total: 4 cross, 2 "T"
Prevailing ROW	99'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class II
Bus Service	Yes
Utilities & Lighting	Underground utilities b/w Pearl–Main; overhead utilities b/w Main–Maple. No ornamental light poles.
Water Systems	On combined sewer, except for the College St. intersection. Likely sandy soils suitable for stormwater infiltration.

Recommendations

Proposed Bike Facility	Protected Bike Lane
Recommended Street Type	To be determined by a future corridor study

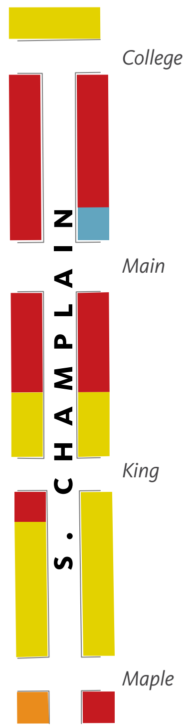


S. CHAMPLAIN ST.

South Champlain is a quiet street bisected within downtown by Urban Renewal activity. Within the downtown area, its ROW is 66', and its traffic counts are relatively low, in part due to its northerly termination at College. Its roadway is only 30', more typical of purely residential blocks.

Design Considerations

Except for the block between College and Main Streets, where on-street metered parking and tour bus stops exist, designers should utilize residential ensembles for this street.



Existing Character/Uses

Urban Regional Linkages	Bisected within downtown; northern section resumes at Pearl Street, connecting to Old North End and the Beltline
Terminus within Downtown	North: housing on College St.
Terrain	Sloped
High Point/Low Point	High: 166' @ College Low: 125' @ Maple
Views	none
Length	1310'
Number of Blocks	West: 3 East: 3
Intersecting Streets	4
Intersections	4 total: 3 cross, 1 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No GMT service; Tour Bus parking between College and Main
Utilities & Lighting	Underground utilities b/w College–Main; overhead utilities b/w Main–Maple. No ornamental light poles.
Water Systems	On combined sewer, except for the College St. intersection. Likely sandy soils suitable for stormwater infiltration.

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	North of Main Street: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68* South of Main Street: *"Downtown Residential Street (66' ROW, 30' Roadway)" on page 78*

Commercial

Civic/ Institutional

Residential

Open Space/Park

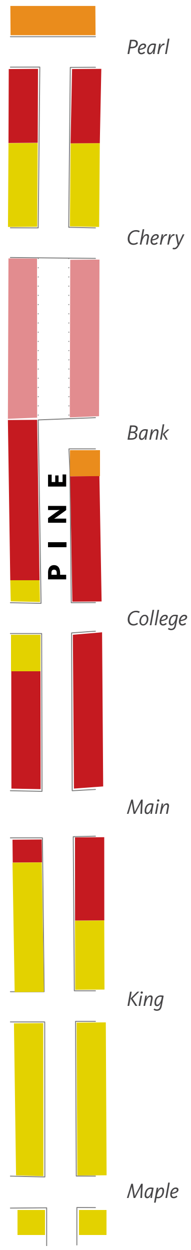
Mixed Use

PINE ST.

Pine Street is a primary link into downtown from the south, and some of its features will be upgraded as far north as Main Street as part of the Champlain Parkway project. Pine Street has a number of unusual features. Within its 66' ROW, its character changes from residential on the south to increasingly dense commercial on the north; notably, a restored block between Bank and Cherry will pass by the Burlington City Place (BCP) redevelopment. The northernmost block is a mix of residential and commercial uses, is adjacent to the parking lot for the Cathedral of the Immaculate Conception, and then terminates at a mixed-use block on Pearl.

Design Considerations

It is a strong candidate for direct application of the typical slow street standards for streets with 66' ROW. South of Main Street, the corridor is an important bus route. planBTV Walk/Bike indicates that Pine Street should have conventional bike lanes or shared lane markings based on width and location of on-street parking.



Existing Character/Uses

Urban Regional Linkages	South: Major connector to Queen City Park
Terminus within Downtown	Pearl St on North
Terrain	Sloped
High Point/Low Point	High: 220' @ Pearl Low: 125' @ Maple
Views	none
Length	2190' (2530')
Number of Blocks	West: 5 East: 5 (6)
Intersecting Streets	7
Intersections	7 total: 5 cross, 2 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III b/w Pearl–Cherry, Bank–Main Class II b/w Main–Maple
Bus Service	Yes
Utilities & Lighting	Underground utilities b/w Bank–Main; overhead utilities b/w Main–Maple. No ornamental light poles.
Water Systems	Combined sewer except for College St. intersection; possible sandy soils for infiltration

Recommendations

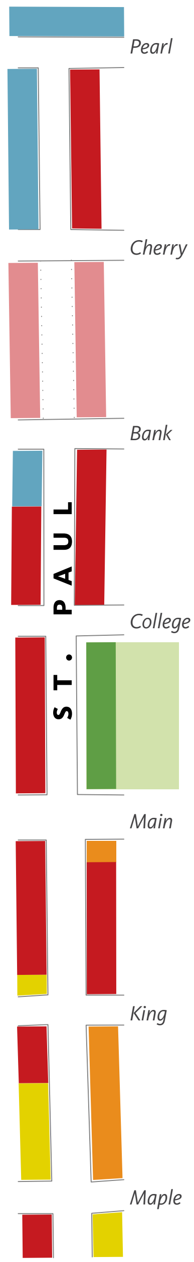
Proposed Bike Facility	Shared Use Lane Markings and/or Buffered/ Conventional Bike Lanes
Recommended Street Type	North of Cherry Street: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68* Cherry to Bank Street *"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72* Bank to Main Street: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68* Main to King Street: *"Commercial Slow Street with Transit (66' ROW, 36' Roadway)" on page 70*

ST. PAUL ST.

St. Paul serves as a gateway into downtown from Route 7 and Shelburne Street from the south. The redevelopment of the private Burlington City Place (BCP) property anticipates that the block between Cherry and Bank Streets will be re-established, where it will terminate at the new transit center. Its prevailing ROW is 66'; however, there are several exceptions, including south of Main where it was made wider to accommodate diagonal parking, and on the proposed BCP block, which will only be 60'. The block that adjoins City Hall Park is currently closed to vehicles during the Saturday Farmers Market, and was recently reconstructed. St. Paul has numerous historic structures, and will be home to the new Eagle's Landing development of Champlain College between King and Maple.

Design Considerations

The City Hall Park "pinwheel concept" treats St. Paul and Church Streets as an important parallel pair that bracket City Hall Park. Designers should, in applying the standards, look for ways to emphasize this distinct relationship particularly through improvements that appeal to pedestrians, enhance downtown's stormwater management infrastructure, and ensure a high level of investment in signage and other street furnishings, as well as "turn-key" street light poles that can accommodate banners and special holiday lighting.



Existing Character/Uses

Urban Regional Linkages	South: Major historic connector to Shelburne Rd.
Terminus within Downtown	North: storefronts @ Pearl
Terrain	Gently sloped
High Point/Low Point	High: 222' @ Pearl Low: 149' @ Maple
Views	none
Length	2190' (2530')
Number of Blocks	West: 5 (6) East: 5 (6)
Intersecting Streets	7
Intersections	7 total: 4 (6) cross, 3 (1) "T"
Prevailing ROW	66' b/w Pearl–Main 82.5' b/w Main–Maple
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III b/w Pearl–Cherry, Bank–Main Class II b/w Main–Maple
Bus Service	Yes, b/w Pearl–Cherry (Transit Center), and south of Main St
Utilities & Lighting	Underground utilities b/w Pearl–Cherry, Bank–King; overhead b/w King–Maple. Ornamental light poles b/w College–Main.
Water Systems	Primarily combined (may be some slippage of runoff to separate system). Soil conditions are unknown

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	North of Cherry Street: *"Commercial Slow Street with Transit (66' ROW, 36' Roadway)" on page 70* Cherry to Bank Street *"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72* South of Bank Street: *"Commercial Slow Street with Transit (66' ROW, 36' Roadway)" on page 70*

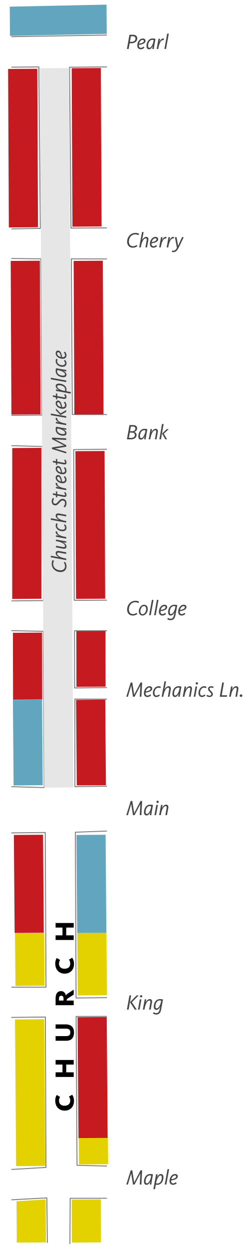
CHURCH ST.

For several decades, Church St. has been the primary commercial street in downtown. The removal of motor vehicles (except deliveries) and the creation of the Church Street Marketplace proved to be an enormous social and economic success, and cemented Church Street as the most active street in downtown for pedestrian and retail activity. The absence of vehicles also made it unique, as did the creation of a separate management and oversight entity. Finally, the investments in the physical design of the street itself further ensure its unique character and role in downtown.

These standards seek to preserve that special identity, while more fully integrating Church Street Marketplace with other downtown streets, and with City Hall Park. For example, the standards call for expanding the installation of Church's ornamental street lights through most of downtown, but do not extend its special and distinctive paving beyond a limited section of Main and College Streets to connect to City Hall Park. Importantly, these standards are not intended to replace the materials and furnishing currently in use on the Marketplace, nor apply the unique Marketplace furnishings wholesale throughout the rest of downtown.

Design Considerations

The two southern blocks of Church are more typical of the rest of downtown, with 66' ROW, 35' roadway, and a mix of civic, commercial and residential uses. The standards should be judiciously applied to these blocks where some streetscape improvements have already been implemented, notably between Main and King.



Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	North: Unitarian Church @ Pearl
Terrain	Gently sloped
High Point/Low Point	High: 228' @ Pearl Low: 160' @ Maple
Views	Terminal view of First Unitarian Universalist Church
Length	2520'
Number of Blocks	West: 6 East: 6
Intersecting Streets	7
Intersections	7 total: 6 cross, 1 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class IV b/w Pearl–Main Class III b/w Main–Maple
Bus Service	No
Utilities & Lighting	Underground utilities b/w Pearl–King; overhead utilities b/w King–Maple. Ornamental light poles b/w Pearl–King.
Water Systems	Combined sewer. Some reports of sewer surcharge in buildings likely from roof drains not being able to drain to systems

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	North of Main: No recommended changes South of Main: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68*

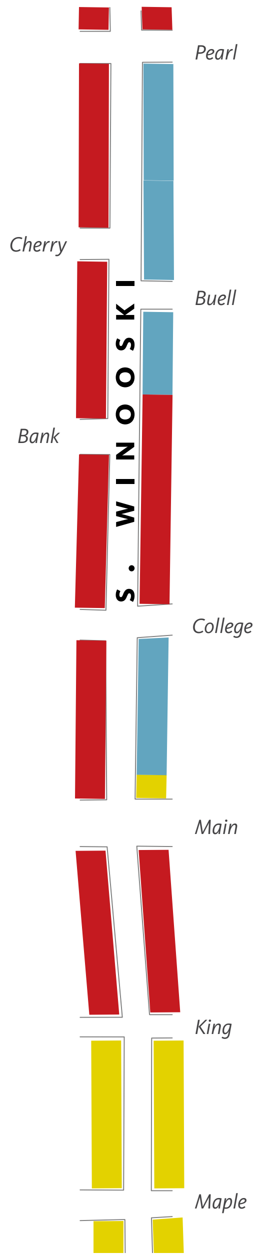
Commercial	
Civic/ Institutional	
Residential	
Open Space/Park	
Mixed Use	

S. WINOOSKI AVE.

Winooski is an important connector street from the north. The blocks between Pearl and King Streets are distinctly different from the one between King and Maple, which is primarily residential and has relatively low traffic counts. From Pearl to Main, traffic counts are high, and a 40' roadway handles four lanes of traffic (the only street to do so besides Battery) within a 66' ROW. The street is more automobile-oriented than most in downtown, in that it has numerous driveway curb cuts and street-fronting parking lots. Its intersection with Main Street is the location of highest traffic counts and crashes, and is also the site for the potentially greatest transformation from the proposed redevelopment of the "Gateway Block"—the eastern corners of Main and Winooski—per the planBTV Downtown & Waterfront Master Plan.

Design Considerations

Though Winooski and Union are very different streets in character, use and dimension, their location within the larger traffic network makes them an operational pair. North and south of downtown, Winooski is a one-way street traveling south, while Union accommodates one-way traffic traveling north. Any future redevelopment of the Gateway Block will have a major impact on the design and operation of both streets. Furthermore, planBTV Walk/Bike calls for a protected bike lane on S. Winooski within the downtown area. These streets will benefit from a dedicated master plan to evaluate how these streets can meet their current and future transportation demands. The City began a scoping study for lane configuration options for this pair of streets in 2017.



Existing Character/Uses

Urban Regional Linkages	North: major historic connector to Winooski
Terminus within Downtown	none
Terrain	Gently sloped
High Point/Low Point	High: 232' @ Pearl Low: 185' @ King
Views	none
Length	2530'
Number of Blocks	West: 6 East: 5
Intersecting Streets	7
Intersections	7 total: 6 cross, 1 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class I
Bus Service	Yes
Utilities & Lighting	Underground utilities b/w Pearl–King; overhead utilities b/w King–Maple. Decorative light poles b/w Pearl–Main.
Water Systems	Combined sewer system

Recommendations

Proposed Bike Facility	Protected Bike Facility
Recommended Street Type	Pearl to Main: *"Major Commercial Street (66' ROW, 38' Roadway)" on page 74* Main to King: *"Commercial Slow Street (66' ROW, 35' Roadway)" on page 68* King to Maple" *"Downtown Residential Street (66' ROW, 30' Roadway)" on page 78*

Commercial
Civic/ Institutional
Residential
Open Space/Park
Mixed Use

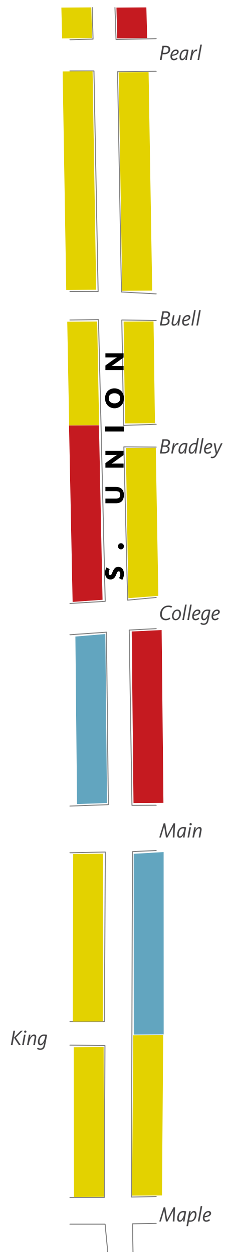
S. UNION ST.

Design Considerations

S. Union is primarily a residential street that marks the eastern edge of the downtown core. Because of the location of the library, College Street Congregational, Memorial Auditorium and Edmunds School along College and Main, as well as the strong pedestrian, bike, transit and vehicular linkages up the hill to Champlain College and UVM, Union has a blended role as both a residential street and a downtown access corridor. As one of the options for entering Burlington from the south at Route 7/ Shelburne St., S. Union acts as a one-way relief corridor for the northbound traffic loads on Winooski, and this role may only intensify if the proposed "gateway" sites are redeveloped as planned. Therefore, the design challenge on Union is to maintain the residential scale and character while accommodating traffic requirements, all on a 30' roadway within a 66' ROW.

Design Considerations

Though Winooski and Union are very different streets in character, use and dimension, their location within the larger traffic network makes them an operational pair. North and south of downtown, Winooski is a one-way street traveling south, while Union accommodates one-way traffic traveling north. Any future redevelopment of the Gateway Block will have a major impact on the design and operation of both streets. Furthermore, planBTV Walk/Bike calls for a protected bike lane on S. Winooski within the downtown area. These streets will benefit from a dedicated master plan to evaluate how these streets can meet their current and future transportation demands. The City began a scoping study for lane configuration options for this pair of streets in 2017.



Existing Character/Uses

Urban Regional Linkages	Connector to Winooski and Shelburne Rd.
Terminus within Downtown	none
Terrain	Gently sloped
High Point/Low Point	High: 238' @ Pearl Low: 214' @ Bradley
Views	none
Length	2530'
Number of Blocks	West: 5 East: 5
Intersecting Streets	7
Intersections	7 total: 5 cross, 2 "T"
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities b/w Pearl–Maple. No ornamental light poles.
Water Systems	Combined sewer. Likely to have tighter soils and ground water. High velocity runoff from Bradley St. and other steep sloped intersecting streets impact stormwater management on this street.

Recommendations

Proposed Bike Facility	Protected Bike Lane
Recommended Street Type	North of Main Street: *"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72* South of Main Street: *"Downtown Residential Street (66' ROW, 30' Roadway)" on page 78*

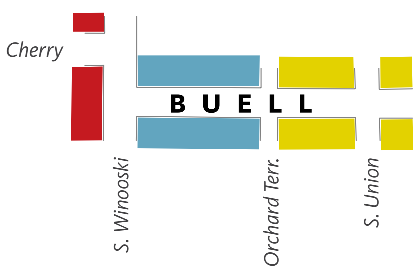
Other Streets

BUELL ST.

Buell is a handsome residential street with one-way eastbound traffic. Its gateway block runs between two historic church structures at Winooski Avenue, and continues east up the hill. It has a 30' roadway within a 66' ROW, typical for downtown residential blocks.

Design Considerations

The sidewalk and tree belt design should be improved for stormwater capture where possible. However, preserving healthy trees on this street should take priority over improvements to stormwater collection that would necessitate the removal or destruction of these trees.



Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	West: Marketplace Garage
Terrain	Gently sloped
High Point/Low Point	High: 226' @ Low: 217' @ Union
Views	none
Length	580'
Number of Blocks	North: 2 South: 2
Intersecting Streets	3
Intersections	3 total: 3 cross
Prevailing ROW	66'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities b/w Winooski–Union. No ornamental light poles.
Water Systems	Combined sewer system. Infill over old ravine.

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	*"Downtown Residential Street (66' ROW, 30' Roadway)" on page 78*

Commercial

Civic/ Institutional

Residential

Open Space/Park

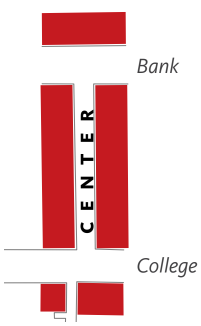
Mixed Use

CENTER ST.

Center Street is a charming one-block anomaly within the continuous grid of downtown. It has a ~24' one-way northbound roadway within a 36' ROW, both of which are exceptionally narrow. There is currently no treebelt or stormwater capture. The block's low traffic counts make it desirable as a pedestrian and bike route and destination, but its existing sidewalks (6' west side and 8' east side) are too narrow to adequately support such uses.

Design Considerations

This is a good candidate for testing possible pilot projects, including permeable parking lanes in conjunction with stormwater and other innovative strategies.



Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	North: Gas station at Bank South: Storefronts @ College
Terrain	Gently sloped
High Point/Low Point	High: 220' @ Bank Low: 207' @ College
Views	none
Length	465'
Number of Blocks	1
Intersecting Streets	2
Intersections	2 total: 2 cross
Prevailing ROW	36'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Future Design Speed	≤ 25 MPH
Bus Service	No
Utilities & Lighting	Underground utilities with decorative light poles.
Water Systems	Combined sewer system. Soils are unknown

Recommendations

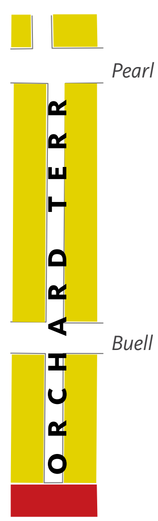
Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	*"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72*

ORCHARD TERRACE

Within the downtown core, there are two residential blocks of Orchard Terrace "hidden" just outside of the commercial core, with a one-way, northbound 25' roadway within a 35' ROW.

Design Considerations

Most of this street lacks a tree belt, and therefore, alternative stormwater infrastructure.

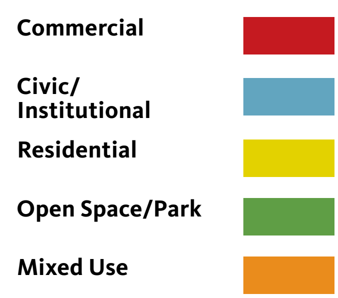


Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	North: Private home @ Pearl South: Cul-de-sac/City Market
Terrain	Gently sloped
High Point/Low Point	High: 236' @ Pearl Low: 218' @ end of street
Views	none
Length	780'
Number of Blocks	2
Intersecting Streets	2
Intersections	2 total: 2 cross
Prevailing ROW	35'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities. No ornamental light poles.
Water Systems	Sanitary sewer only. Unknown soil conditions.

Recommendations

Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	No proposed change

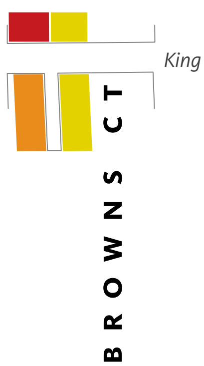


BROWNS COURT

Browns Court is a half-block, dead-end street lying between residences and the Champlain College's Eagles Landing project. It has a 20' roadway within a 30' ROW, along with overhead utilities. It is a unique condition within downtown.

Design Considerations

The City has leased this street to Champlain College for maintenance and improvements through 2066. Any modification of the street by Champlain College should include the judicious application of these standards to this special condition. This street is a good candidate for a shared street.



Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown
Terminus within Downtown	North: housing @ King South: dead end @ Eagle's Landing
Terrain	Flat
High Point/Low Point	High: 172' @ end of street Low: 171' @ King
Views	none
Length	150'
Number of Blocks	1
Intersecting Streets	1
Intersections	1 total: 1 cross
Prevailing ROW	30'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	No
Utilities & Lighting	Overhead utilities. No ornamental light poles.
Water Systems	Sanitary sewer only. Soil conditions unknown, but likely not sandy.

Recommendations

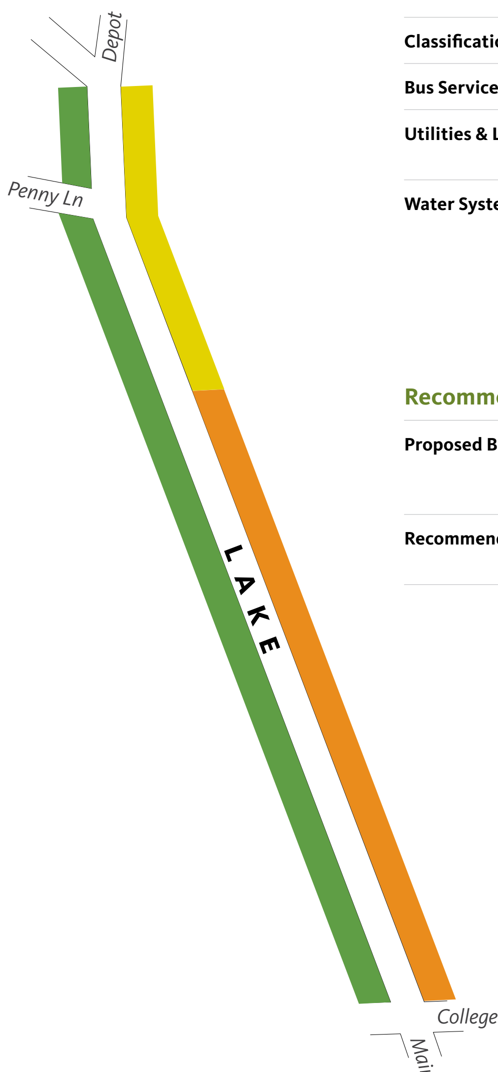
Proposed Bike Facility	Shared Right-of-Way
Recommended Street Type	No proposed change

LAKE STREET

Lake Street is the only north-south street connecting the downtown core directly to waterfront amenities. While it functions as the edge between downtown and the waterfront, its relatively flat elevation adjacent to the Battery Park Hill make it feel separated from the rest of downtown, particularly by pedestrians and bicyclists. From many points along the corridor, particularly north of Pease Lot, one can catch a glimpse of Lake Champlain and Adirondacks. Newer redevelopment activity along the east side, and the improvements to Waterfront Park and Waterfront Access North (skatepark) have increased vehicular, pedestrian and bicycle traffic in this corridor. Lake Street was studied in the 2007 Waterfront/ College Street Access Plan, which included recommendations for improving transportation circulation, aesthetics, and wayfinding. Lake Street was also studied in 2009 as part of the Waterfront Access North Scoping Study, with recommendations for the corridor primarily focused on improving stormwater management, and for potential east-west connections from Battery Street to Lake Street.

Design Considerations

The sidewalk and tree belt design should improve the grade of the street to better handle stormwater capture and conveyance, to address areas of localized flooding.



Existing Character/Uses

Urban Regional Linkages	Lies entirely within Downtown from Depot Street to College Street
Terminus within Downtown	North: Waterfront Skate Park South: College Street intersection
Terrain	Flat
High Point/Low Point	High: 113' Low: 106'
Views	Lateral views of Waterfront Park and the lake and mountains to the west
Length	1584'
Number of Blocks	3
Intersecting Streets	Penny Lane, Depot Street, College Street
Intersections	3 total: 1 cross 2 "T"
Prevailing ROW	49.5'
Prevailing Roadway	Review existing street dimensions on *page 64*.
Classification	Class III
Bus Service	From College Street to access Pease Lot
Utilities & Lighting	Ornamental Street Lighting - Pole Top mounted fixtures
Water Systems	Separate storm/sanitary sewer. Majority stormwater managed by swales on west side of road, discharging to Lake Champlain. Sand filter system at north end near skatepark/Depot Street. Near College Street, discharging to College St. separate stormwater system.

Recommendations

Proposed Bike Facility	Shared Use Lane Markings with Traffic Calming to intersections with Bike Path/ Depot Street
Recommended Street Type	*"Minimum Commercial Street (66' ROW, 28' Roadway)" on page 72*

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3 Building Great Streets

Dimensions, Assemblies & Placemaking

Transforming Burlington's rights-of-way into "Great Streets" requires standards for design.

This section should be consulted as the starting point for any construction project within Burlington's downtown rights-of-way, in order to ensure project design meets all required standards. This section provides standard cross-sections for streets based on the recommended curb-to-curb dimensions, guidance on the layout of elements within the right-of-way and at intersections, and the minimum required and preferred dimensional standards for all of the "zones" of the right-of-way. This section draws on both state and local requirements, as well as industry guidance and best practices. Finally, this section provides guidance for "placemaking" options when the right-of-way is constrained, thus making it difficult to incorporate the preferred dimensions for each of these zones. A summary chart of *"Existing and Proposed ROW and Curb-to-Curb Dimensions" on page 64* outlines all of the streets within the downtown core for quick reference.

Zabby and Elf's *on College St. (Photo credit Voyages Végé)*

Modal Hierarchy

A clear hierarchy of transportation modes is critical to inform design and operation decisions in the public right-of-way. This hierarchy will influence cross-sections, intersection design, signal timing, maintenance scheduling, and other operations. These standards are based on the adopted policies in *planBTV Downtown & Waterfront* and the *Municipal Development Plan* that state that the "pedestrian is king." This means that while streets are designed to improve the quality and functionality for all modes, design solutions that improve safety and accessibility for people who walk-- the most vulnerable users of our streets-- should be prioritized.

To achieve this, the following hierarchies should guide the design of streets based on their role within the downtown core:

Pedestrian > Bicycle > Transit > Automobile along a bicycle priority street with bikeways or a bike corridor

Pedestrian > Transit > Bicycle > Automobile along a major transit corridor

Pedestrians

Most trips begin and end on foot and great street design should embrace this notion. Pedestrians are the life of city streets. Downtowns, with their shopping districts, entertainment areas, and civic institutions, typically bring high volumes of pedestrian activity and require high quality walking environments to go with them.

People who walk are extremely vulnerable to injury when forced to compete for space with vehicles; therefore, the design and operation of streets and intersections must protect them. The needs of pedestrians should alwasy be considered first when designing streets with limited right-of-way. This means optional elements within the ROW should not compromise the minimum required clear sidewalk space. Sidewalks, crosswalks, pedestrian signals, and other pedestrian facilities must accommodate pedestrians of all abilities and comply with the Americans with Disabilities Act (ADA). And finally, all street design, even in cases where pedestrians are not the predominant user, should provide for quality space where people can walk, stroll, or simply sit.

Bicycles

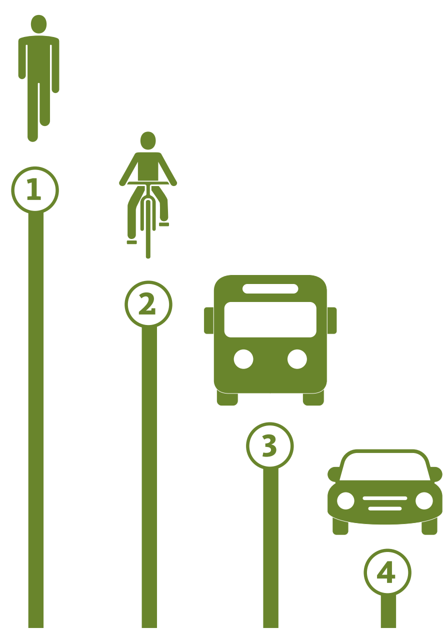
Like pedestrians, bicyclists are vulnerable users of public space who benefit from reduced traffic speed and dedicated facilities. However, bicyclists are significantly different from pedestrians. They travel faster than pedestrians but more slowly and less visibly than automobiles. Their skill level varies greatly, resulting in a wide range of speeds and behaviors. Also, bicycling is a social activity, and people often ride side-by-side or in groups. Bicycle facility selection requires an understanding of the street condition; bicycle usage, volumes, speeds and routes; and automobile level of service. Generally, great street design embraces the notion that vehicles should travel at slower speeds, which allows bicycles to share the right-of-way with other modes, unless *planBTV Walk/Bike* has identified that a specific bike facility is necessary.

Transit

Buses extend the range of access for Burlington residents and visitors. They provide connections to essential services, jobs, housing and recreation and reduce the demand for automobile trips. Buses are a critical element of street design given their size and operational characteristics. The considerations for street design include lane width, intersection design, signal timing (often adjusted to give transit an advantage, transit-signal priority), pedestrian access (street crossings at bus stops), sidewalk design (making room for bus shelters), bus stop placement and design (farside/nearside at intersections, bus pullouts, or bulb outs), and bike lane crossings.

Automobiles

Private automobiles are an integral part of Burlington's circulation system. Even though they have been placed fourth in the modal hierarchy, they are still the first mode choice for most residents and visitors, and as such must be accommodated. However, as vehicles are the least vulnerable to injury, and as technology changes the way the personal vehicle is used, they should be considered within the constraints of lower speeds that encourage more prudent driving. Commercial vehicles will be given more leeway, as the efficient delivery of goods and services is paramount to supporting a healthy economy and meeting needs of local businesses.



"Pedestrian is King" modal hierarchy diagram (walking, cycling, public transit, private vehicle)

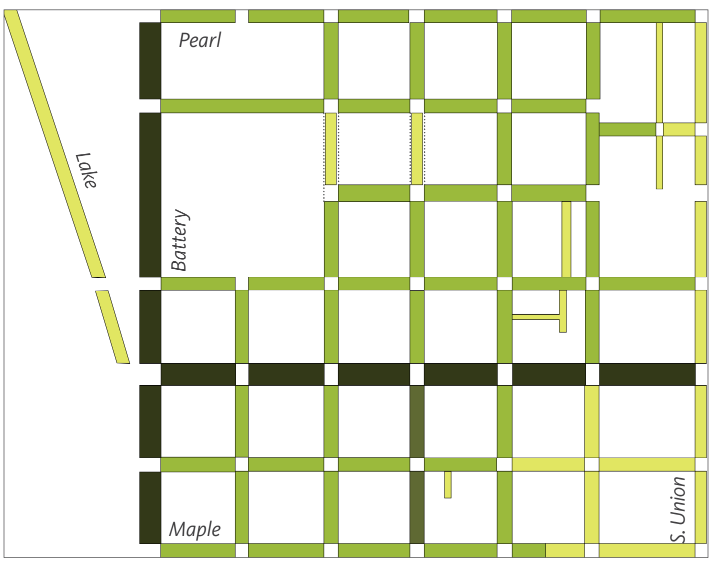
Balancing Right-of-Way Zones

Public Right-of-Way

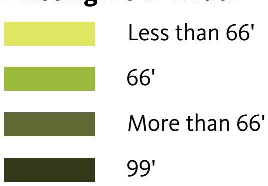
In designing any street in downtown Burlington, the first critical dimension to determine is the width of the ROW, and any encroachments within it. In downtown Burlington street right-of-way is defined as the public space between private property lines, and **there are two prevailing dimensions: 99' and 66'** (see chart on *page 64* for detailed legal and actual ROW widths). Designers should note that the ROW may change from block to block along a given corridor. Further, the effective ROW may be slightly irregular even within a single block. In some cases, this is due to encroachments from older structures that may have been built before modern surveying, or from more recent encroachments by accessory structures such as terraces, staircases, or ramps. In other cases, building faces which are set back from the property line may give the impression of a wider ROW, even though the legal dimension remains the same.

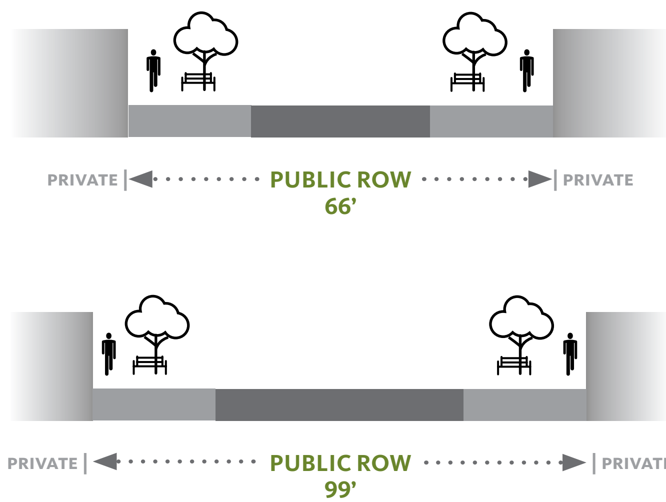
While the right-of-way designation can be changed through legal action, this is relatively rare, and is extremely costly and legally complicated. The critical variable for creating Great Streets is the relative width of the Roadway and Pedestrian Zones within the right-of-way, and ensuring that the proportions of these zones create a balance that achieves the Great Streets principles. Unless otherwise directed, designers may view the right-of-way dimension as permanent parameter of the street design, and seek ways to optimize the dimensions of the prescribed zones by considering the relocation of curbs (see the following sections regarding pedestrian and roadway zones).

The City may wish to consider widening the public ROW along key corridors in order to allow for a more sufficient ROW width to accommodate the corridor's design considerations. This strategy should be pursued selectively, as expanding the legal ROWa does not have the automatic result of creating the physical space to construct a preferred street cross-section. Instead, this will produce an incremental result, with additional space for the pedestrian zone gained as buildings and sites affected by the new ROW dimensions are redeveloped. This should only be considered when existing development patterns would allow for wider ROW without major disruptions to the existing building fabric (i.e. a street has many contiguous properties with buildings setback from the road) and where an entire block/several blocks can be widened together to provide continuity in the streetscape.



Existing ROW Width





There are two prevailing ROW widths in downtown Burlington: 66' and 99'. The standard cross sections assume that the ROW dimension is fixed.

Roadway and Pedestrian Zones

The second critical dimension for street design is the Roadway Zone width—the distance between the curb face on one side and the curb face on the other—and the resulting width of the Pedestrian Zone on either side of the street.

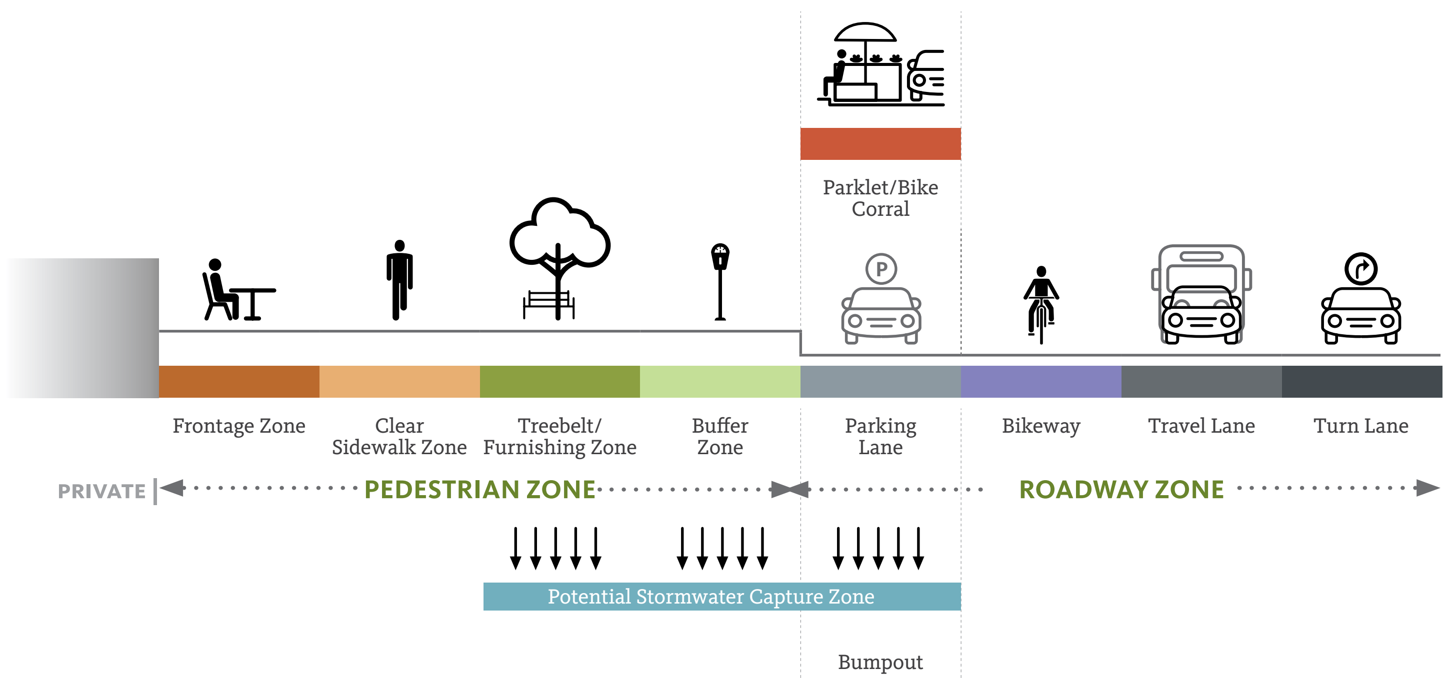
For the purpose of these standards, zones are organized as follows:

- The **Roadway Zone** includes turn lanes, travel lanes, parking lanes, and bicycle lanes. Although parklets function as an extension of the pedestrian zone, they typically occupy space in the parking zone.
- The **Pedestrian Zone** includes the curb, stormwater/ raingardens, buffer zones, tree belt/furnishing zones, clear sidewalk zones, and frontage zones (special circumstances may call for a cycle track to be incorporated into the pedestrian zone).

In *"Roadway & Pedestrian Zone Options" on page 66*, the minimum and recommended dimensions for the Roadway and Pedestrian Zones are based on the individual street types described. While there are some outliers due to larger or smaller ROW, in general the application of these standards will result in the following proportions:

- 40’ roadway zone yields 13.5’ pedestrian zone
- 36’ roadway zone yields 15’ pedestrian zone
- 35’ roadway zone yields 15.5’ pedestrian zone
- 30’ roadway zone yields 18’ pedestrian zone

Elements within Roadway & Pedestrian Zones



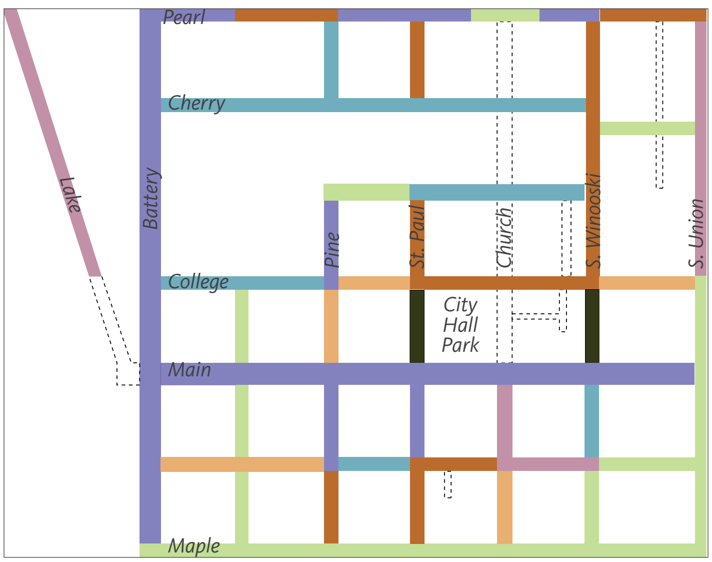
Balacing Roadway & Pedestrian Zones

In Burlington, for downtown commercial streets with building faces at the property line, 13’ Pedestrian Zones are considered to be insufficient, as they limit what can be accomplished outside of the Roadway Zone. Therefore, these standards propose that 15’ pedestrian zones should be considered the desirable dimension on commercial streets. Since the 35’ roadway width yields 15.5’ pedestrian zones, these standards recommend that existing 35’ roadways remain in place. The standards also recommend that where the existing roadway is greater than 35’ wide, it be narrowed in order to achieve this preferred dimension. While this strategy does narrow the Roadway Zone, more than 50% of the ROW remains dedicated to the movement of vehicles, transit and bikes.

Changing the width of the roadway usually involves moving the curb and gutter and its associated systems. The curb location usually determines, or at least indicates, other critical locations such as underground utilities which run parallel to the roadway, and their junctions with “lateral” lines which connect services to adjacent private property. The curb also typically establishes the location for the gutter, storm drains, and sewer system. Changing curb locations is usually more complex and costly than merely moving striped lanes within the roadway, or moving street furnishings within the sidewalk zone. However, in some cases moving the curb location (along with associated stormwater facilities and utility lines) is an essential design tool to rebalance the proportion of roadway to usable pedestrian space for other purposes than vehicular movement, and is significantly less costly and challenging than expanding the ROW.

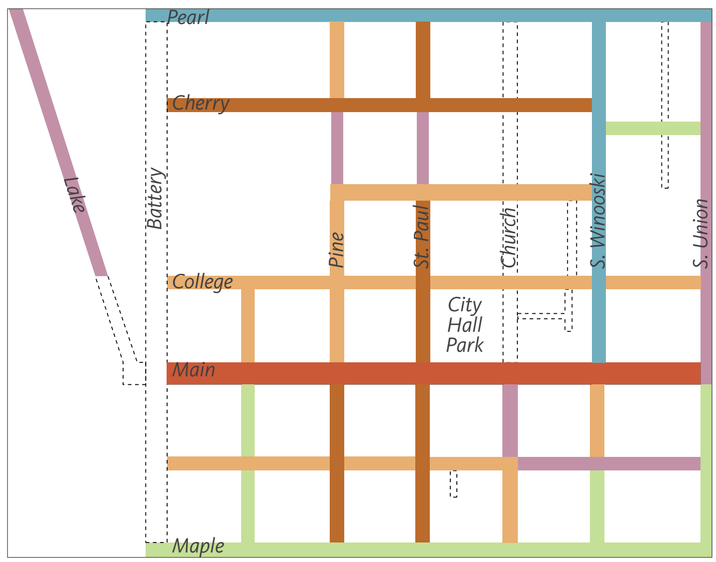
When a project boundary includes an entire block face or more, designers should work with the City to investigate opportunities for relocating the curb to meet the preferred dimension for Roadway and Pedestrian Zones. In some cases, utility relocation, cost, or other unique constraints may prevent the complete redevelopment of the street, but it should be explored as a starting point in all project design.

Curb-to-Curb: Existing



Existing Curb-to-Curb	Proposed Street Type
Less than 30'	Commercial Minimum
30'	Downtown Residential
35'	Commercial Slow Street
36' - 39'	Slow Street with Transit
	Special Commercial
40'	Major Commercial
More than 40'	N/A
	TBD by Corridor Study

Curb-to-Curb: Recommended



Recommended curb-to-curb widths are based on known design considerations. For those streets for which a unique master plan is recommended, the recommended roadway width may be subject to change.

Existing and Proposed ROW and Curb-to-Curb Dimensions

Street	From/To	Existing ROW	Existing Curb-to-Curb	Proposed Curb-to-Curb
Streets with Typical 99' ROW				
Main Street	Union - Winooski, St. Paul - Battery	99'	50'	38'
	Winooski - Church	99'	64'	38'
	Church - St. Paul	99'	50'	38'
	St. Paul - Pine	99'	71'	38'
Battery Street	@ Pearl St. Intersection	99'	59'	TBD
	@ Cherry St. Intersection	99'	46'	TBD
	Cherry - Main	99'	48-49'	TBD
	Main - King	99'	50'	TBD
	King - Maple	99'	45'	TBD
Streets with Typical 66' ROW				
Pearl Street	Union - Winooski	**66'**	37' (45' @ bus berth)	40'
	@ Winooski Intersection	66'	48'	40'
	@ Church Intersection	66'	44' (30' @ curb exten.)	40'
	@ St. Paul Intersection	66'	48'	40'
	Pine - S. Champlain	66'	39'	40'
	S. Champlain - Battery	66'	45'	40'
Cherry Street	Winooski - Battery	66'	40'	36'
Bank Street	Winooski - St. Paul	66'	40'	36'
	St. Paul - Pine	66'	30'	35'
College Street	Union - Winooski	66'	35'	35'
	Winooski - St. Paul	66'	39' (30' @ Church St)	35'
	St. Paul - Pine	66'	35'	35'
	Pine - Battery	66'	40'	35'
King Street	Union - Winooski	50'	30'	28'
	Winooski - Church	40'	27'	28'
	Church - St. Paul	66'	38'	35'
	St. Paul - Pine	66'	40'	35'
	Pine - Battery	66'	35'	35'
Maple Street	Union - Winooski	57.75'	30'	30'
	@ Winooski Intersection	61.75' (west side) 72.75' (east side)	30'	30'
	Church - Battery	66'	30'	30'
S. Winooski Avenue	Pearl - College	66'	39'	40'
	College - Main	66'	44'	40'
	Main - King	57.75'	40'	35'
	King - Maple	57.75'	30'	30'
Church Street	Pearl - Main (Marketplace)	66'	39'	N/A
	Main - King	66'	27'	N/A
	King - Maple	66'	35'	35'
St. Paul Street	Pearl - Cherry	66'	Transit Center	N/A
	Cherry - Bank	To be established @ 60'	N/A	28'
	Bank - College	66'	39'	36'
	College - Main	66'	52'	36'
	Main - King	99' (82.5')	52'	36'
	King - Maple	99' (82.5')	38'	36'

Street	From/To	Existing ROW	Existing Curb-to-Curb	Proposed Curb-to-Curb
Streets with Typical 66' ROW Continued				
Pine Street	Pearl - Cherry	66'	40'	35'
	Cherry - Bank	To be established @ 60'	N/A	28'
	Bank - College	66'	43'	35'
	College - Main	66'	34'	35'
	Main - King	66'	43'	36'
	King - Maple	66'	37'	36'
S. Champlain Street	College - Main	66'	30'	35'
	Main - Maple	66'	30'	30'
Streets with Other ROW Dimensions				
S. Union Street	Pearl–College	**49.5'**	26'	28'
	College–Main	49.5'	30'	28'
	Main–Maple	49.5'	30'	30'
Lake Street	Depot–College	49.5'	20'–28'	20'–28'
Buell Street		60'	28'–29'	30'
Center Street		36'	24'	N/A
Orchard Terrace		35'	20'	N/A
Browns Court		30'	20'	N/A

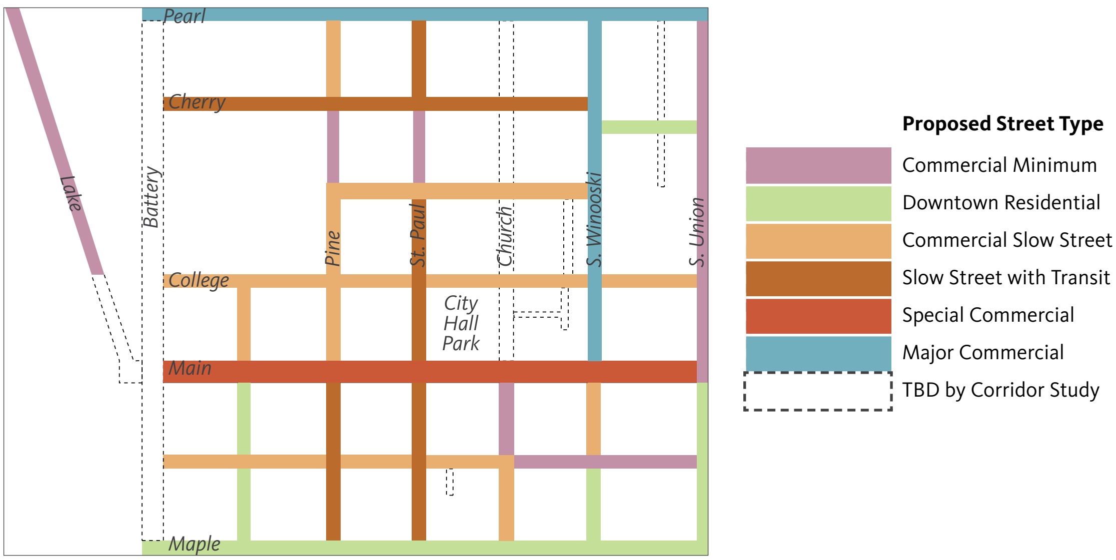
Roadway & Pedestrian Zone Options

Great Street Types

This section provides cross sections and Pedestrian & Roadway Zone options for the following Great Street types.

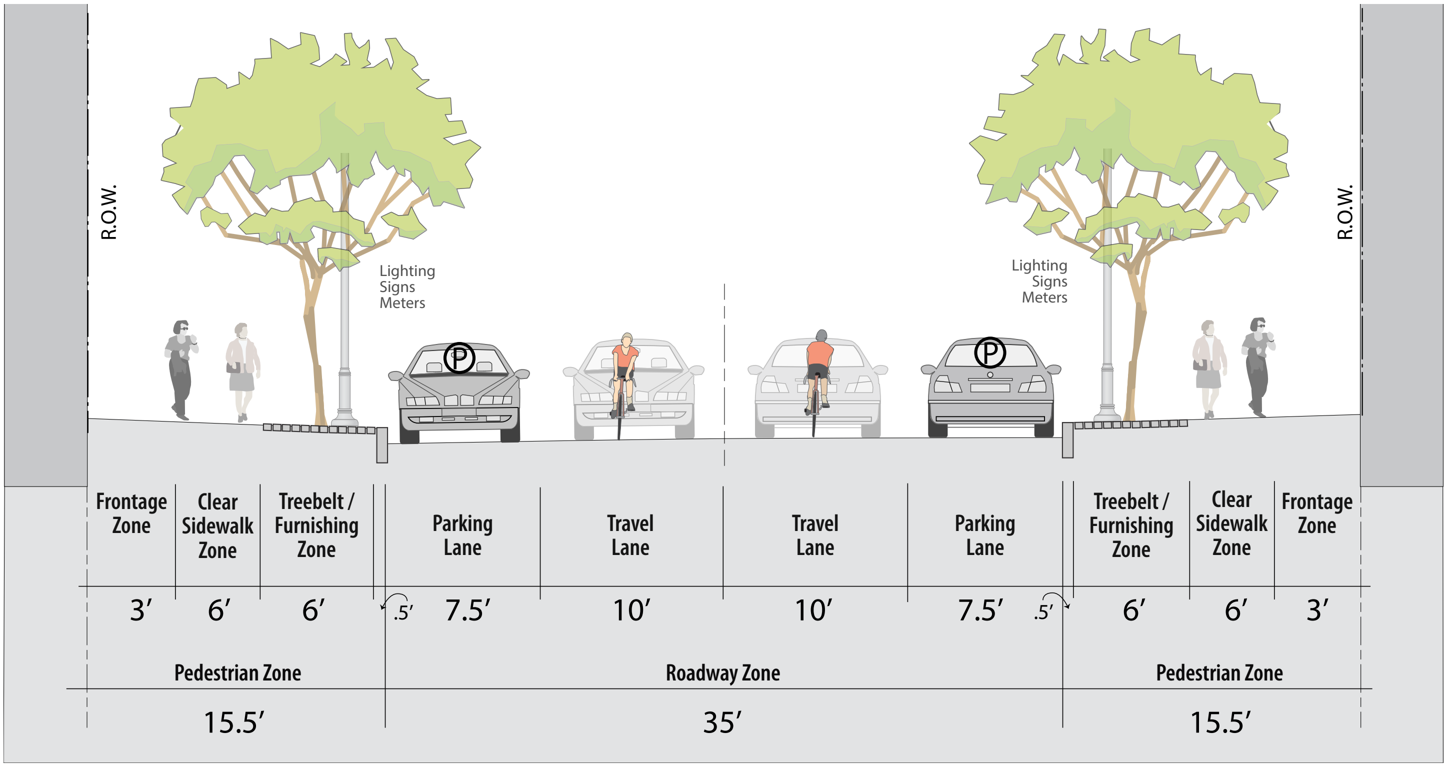
Each Great Street Type includes a typical cross section, options for the layout of laneways in the Roadway Zone, and minmum and recommended elements within the Pedestrian Zone. The street types are based on the assumption that a typical 66' or 99' right-of-way exits; where the actual right-of-way varies from these dimensions, designers should work with the City to determine the most appropriate way to allocate the right-of-way beteween the Roadway and Pedestrian Zones. Options for these zones have been provided based on the standard zone dimensions for *"Roadway Zones" on page 98* and *"Pedestrian Zones" on page 101*. Selection of these options should be informed by the design considerations found in Chapter 2, or by the outcome of a scoping study or other project development process.

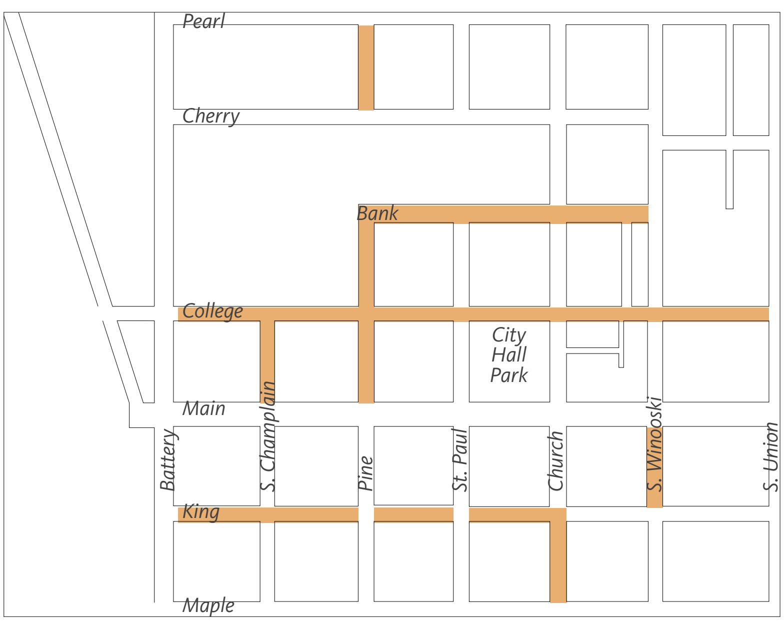
Commercial Slow Street (66' ROW, 35' Roadway)
Commercial Slow Street with Transit (66' ROW, 36' Roadway)
Minimum Commercial Street (66' ROW, 28' Roadway)
Major Commercial Street (66' ROW, 40' Roadway)
Special Commercial Street (99' ROW, 38' Roadway)
Downtown Residential Street (66' ROW, 30' Roadway)



Commercial Slow Street (66' ROW, 35' Roadway)

35' Roadway Zone—31' Pedestrian Zone





Roadway Zone Options

Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

Note: Arrows indicate direction of travel.

Typical Cross Section

▼	▼	▲	▲
Park	**Travel**	**Travel**	**Park**
7.5'	**10'**	**10'**	**7.5'**

Alternative Options

▼	▼	▲	▲
Bike	**Travel**	**Travel**	**Bike**
5' + 2.5'	**10'**	**10'**	**2.5' + 5'**

▼	▼	▲	▲
Park	**Travel**	**Travel**	**Bike**
7.5'	**10'**	**10'**	**2.5' + 5'**

Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.

15.5 FEET	**Curb**	**Buffer Zone ***	**Tree Belt/ Furnishing Zone**	**Clear Sidewalk Zone ****	**Frontage Zone *****
Preferred	**6"**	**0'**	**6'**	**6'**	**3'**
Minimum	**6"**	**0'**	**6'**	**5'**	**0'**

* A 12″ buffer is required in addition to the 6″ curb, in order to meet the 18″ minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12″ of the tree belt.

**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

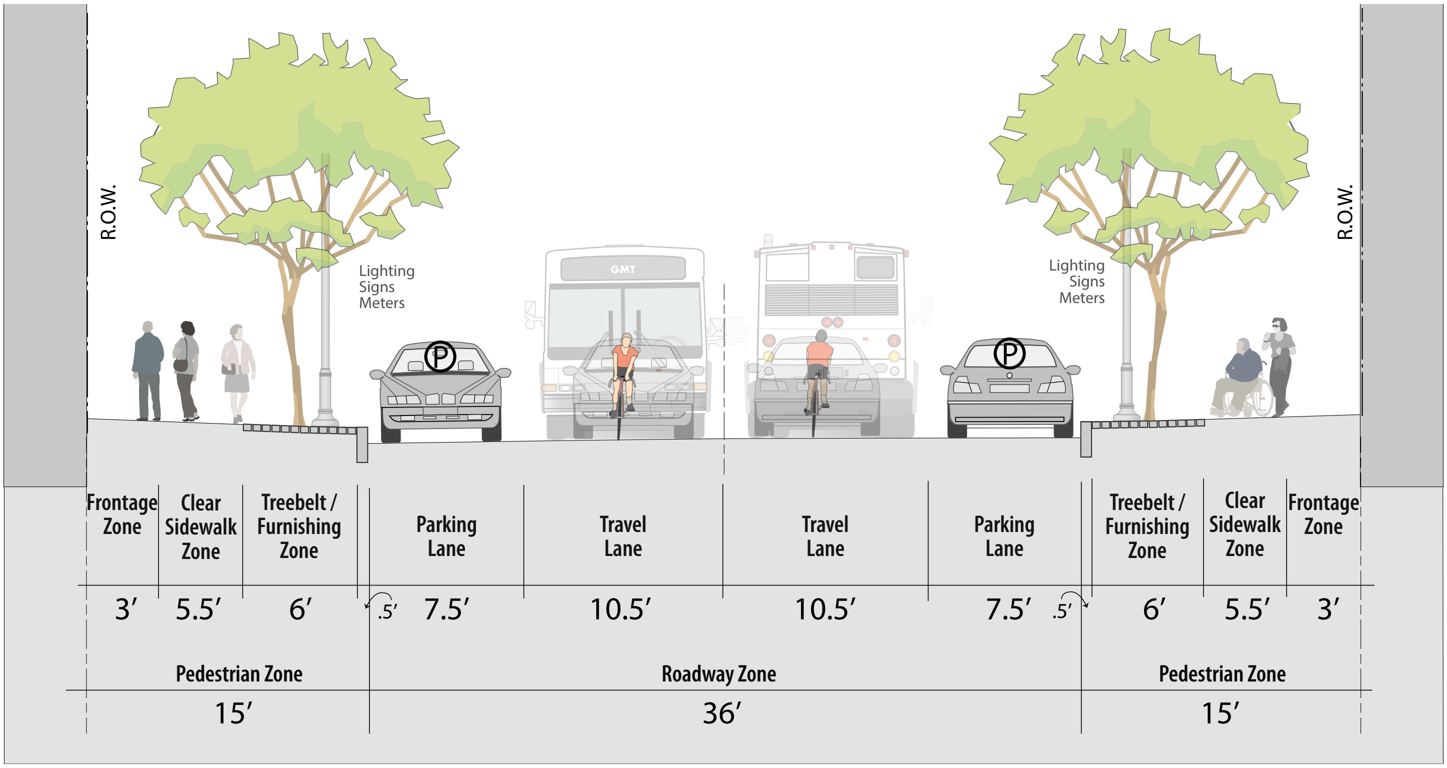
*** Minimum 1' Frontage Zone required next to built structure.

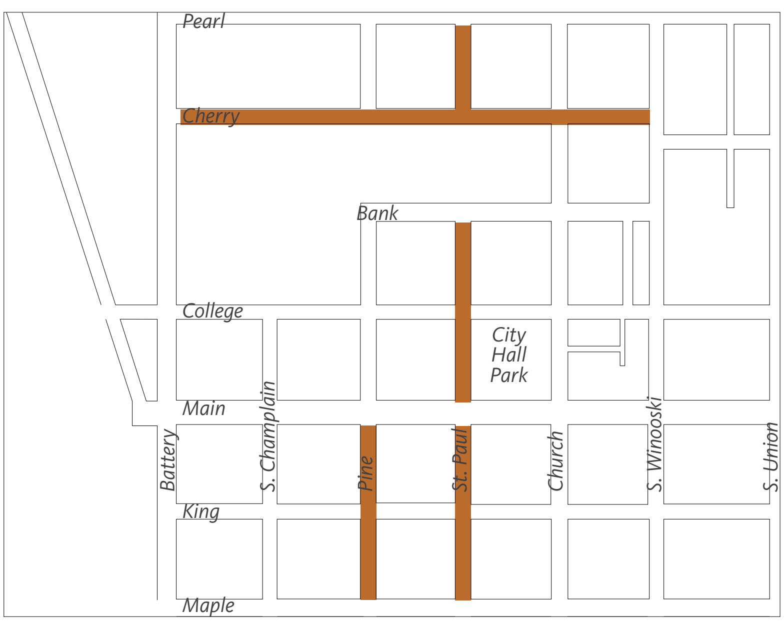
General Notes

- **Design speed:** ≤ 20 MPH
- **Traffic types:** private vehicle, bike, ped, local deliveries, limited thru traffic, transit.
- **Typical parking type:** parallel
- **Typical bike facility:** shared right-of-way, except where noted
- **Typical travel lane:** 10' preferred

Commercial Slow Street with Transit (66’ ROW, 36’ Roadway)

36' Roadway Zone—30' Pedestrian Zone



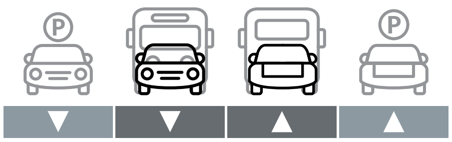


Roadway Zone Options

Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

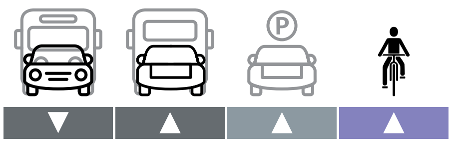
Note: Arrows indicate direction of travel.

Typical Cross Section

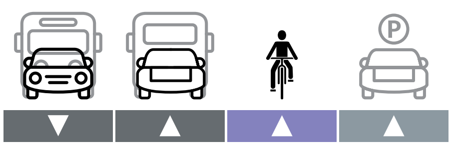


Park	Travel	Travel	Park
7.5'	10.5'	10.5'	7.5'

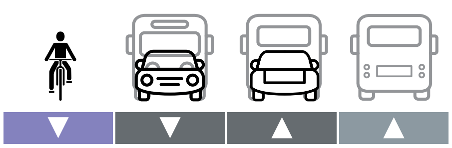
Alternative Options



Travel	Travel	Park	Bike
10.5'	10.5'	7.5'	2.5' + 5'



Travel	Travel	Bike	Park
10.5'	10.5'	2.5' + 5'	7.5'



4.5'	10.5'	10.5'	10.5' Approaching intersection

Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.

15FEET	Curb	Buffer Zone *	Tree Belt/ Furnishing Zone	Clear Sidewalk Zone **	Frontage Zone ***
Preferred	6"	0'	6'	5.5'	3'
Minimum	6"	0'	6'	5'	0'

* A 12″ buffer is required in addition to the 6″ curb, in order to meet the 18″ minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12″ of the tree belt.

**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

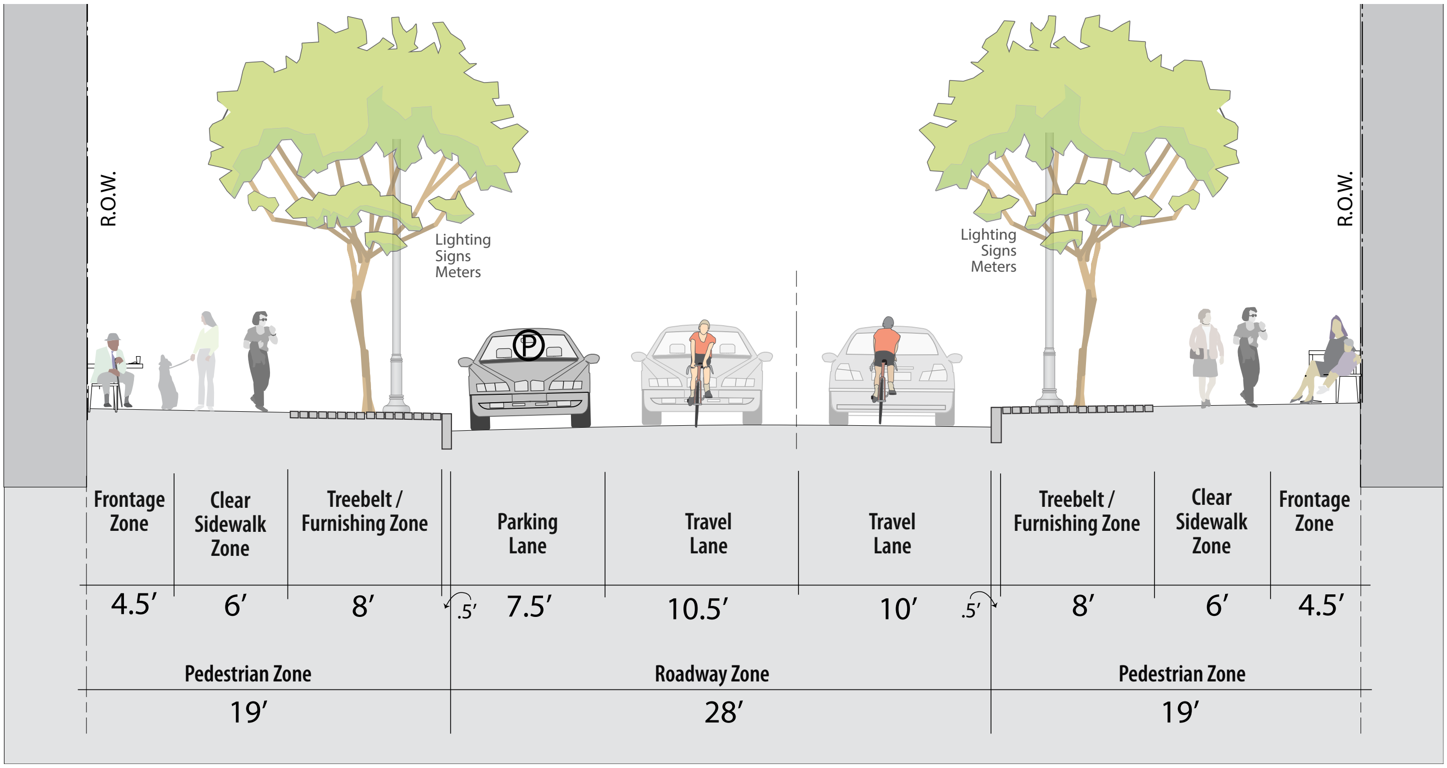
*** Minimum 1' Frontage Zone required next to built structure.

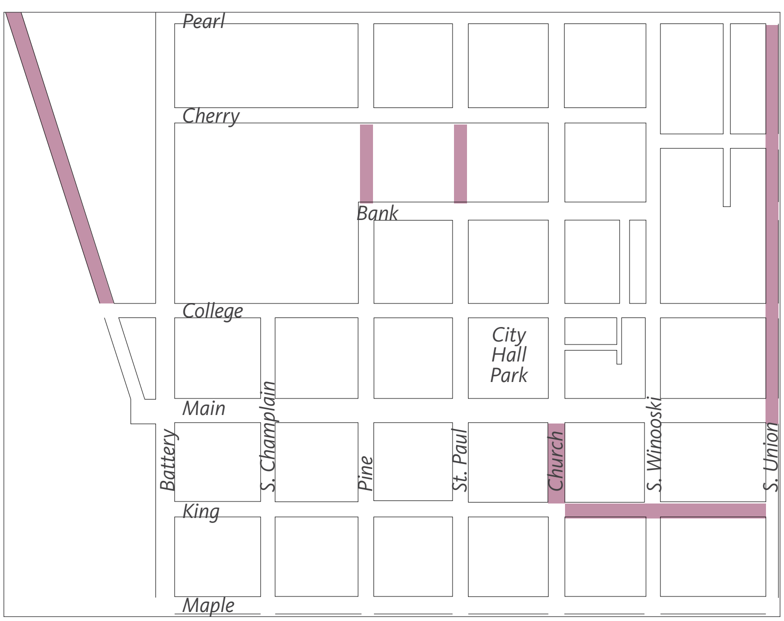
General Notes

- **Design speed:** ≤ 20 MPH
- **Traffic types:** transit, private vehicle, bike, ped, local deliveries, thru traffic
- **Typical parking type:** parallel
- **Typical bike facility:** shared right-of-way, except where noted
- **Typical travel lane:** 10.5'

Minimum Commercial Street (66’ ROW, 28’ Roadway)

28' Roadway Zone—38' Pedestrian Zone





Roadway Zone Options

Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

Note: Arrows indicate direction of travel.

Typical Cross Section

Travel	Travel	Park
10'	10.5'	7.5'

Alternative Options

Travel	Travel	Bike
10'	10.5a'	2.5' + 5'

Park	Travel	Park
7.5'	13'	7.5'

Can also accomodate all modes of travel in opposite direction.

Park	Travel	Bike
7.5'	13'	2.5' + 5'

Can also accomodate all modes of travel in opposite direction.

Travel	Park	Bike
13'	7.5'	2.5' + 5'
12.5'	*7.5'*	*4' + 4'*

Italics represent option for two-way bike way with no buffer.

Park	Bike	Travel
7.5'	5' + 2.5'	13'
	Left-side lane	

Park	Bike	Travel
7.5'	5' + 2.5'	13'

Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.

19 FEET	Curb	Buffer Zone *	Tree Belt/ Furnishing Zone	Clear Sidewalk Zone **	Frontage Zone ***
Preferred	6"	0'	8'	6'	4.5'
Minimum	6"	0'	6'	5'	1'?

* A 12" buffer is required in addition to the 6" curb, in order to meet the 18" minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12" of the tree belt.

**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

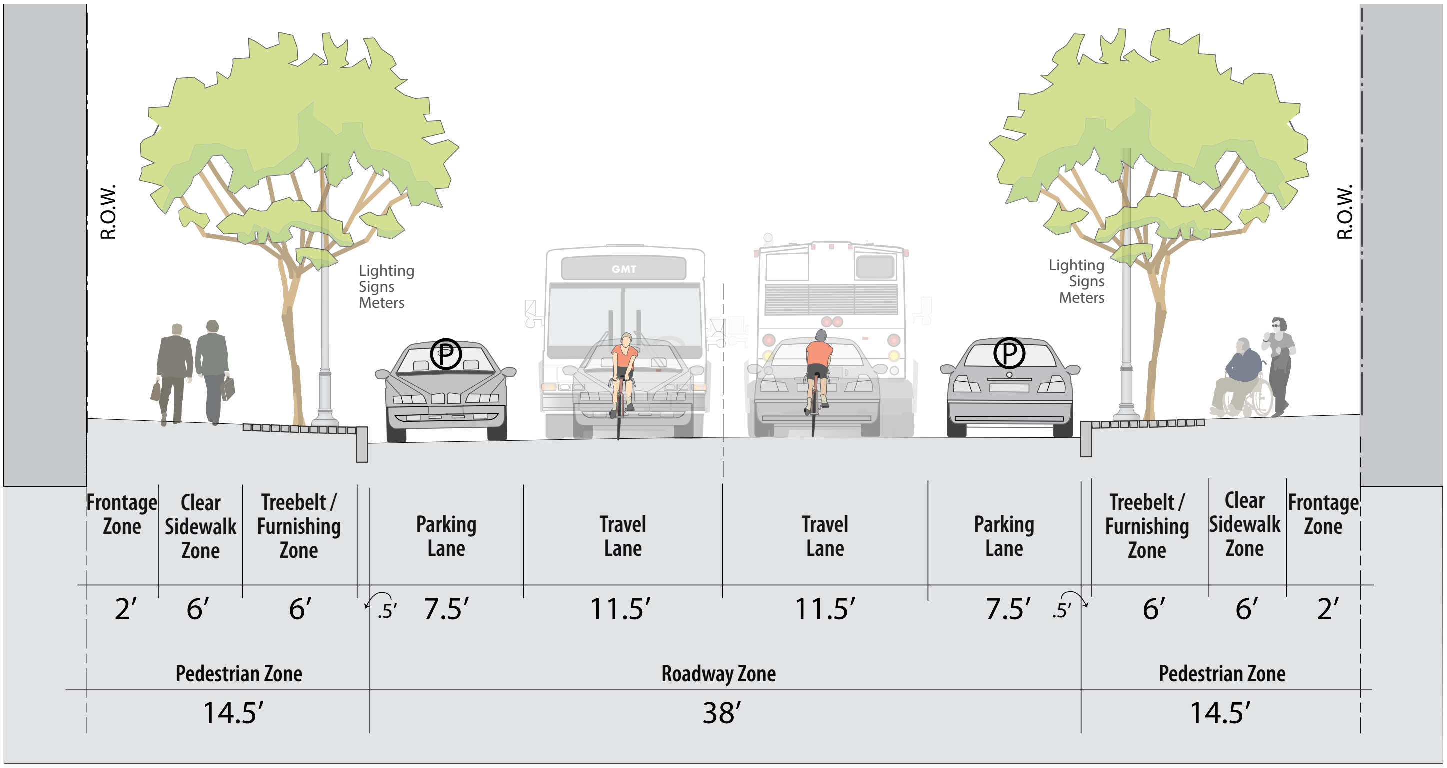
*** Minimum 1' Frontage Zone required next to built structure.

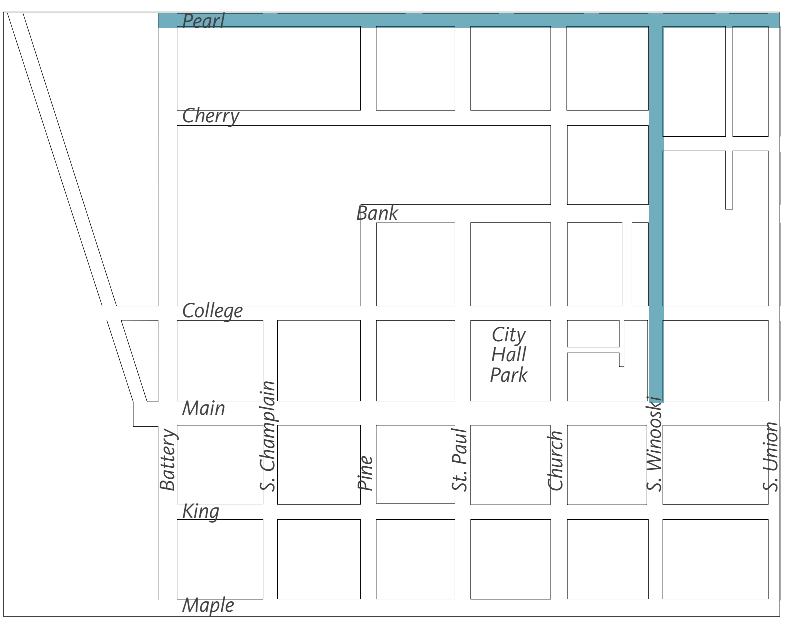
General Notes

- **Design speed:** ≤ 20 MPH
- **Traffic types:** private vehicle, bike, ped, limited deliveries, thru traffic, limited transit.
- **Typical parking type:** parallel
- **Typical bike facility:** shared right-of-way or separated facility; see street design considerations
- **Typical travel lane:** 10' preferred

Major Commercial Street (66’ ROW, 38’ Roadway)

38' Roadway Zone—29' Pedestrian Zone

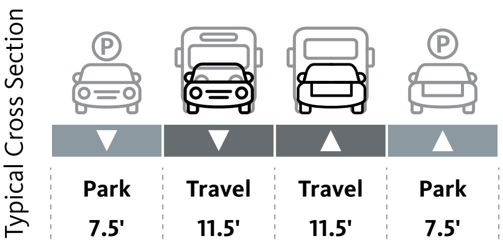


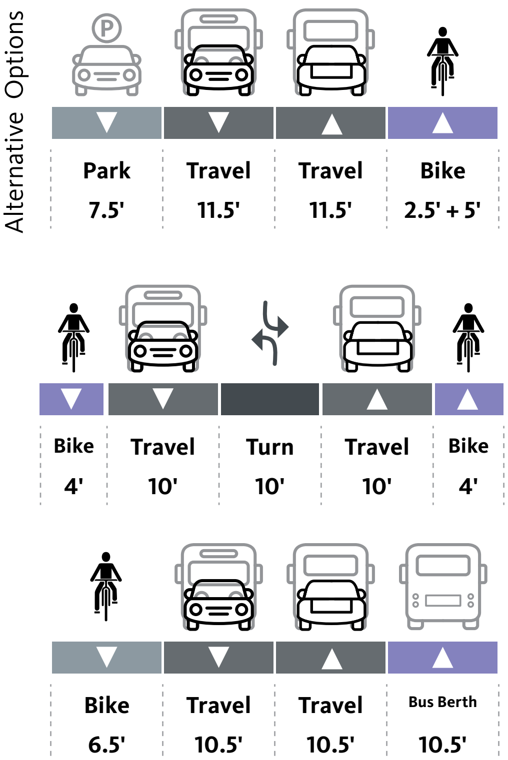


Roadway Zone Options

Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

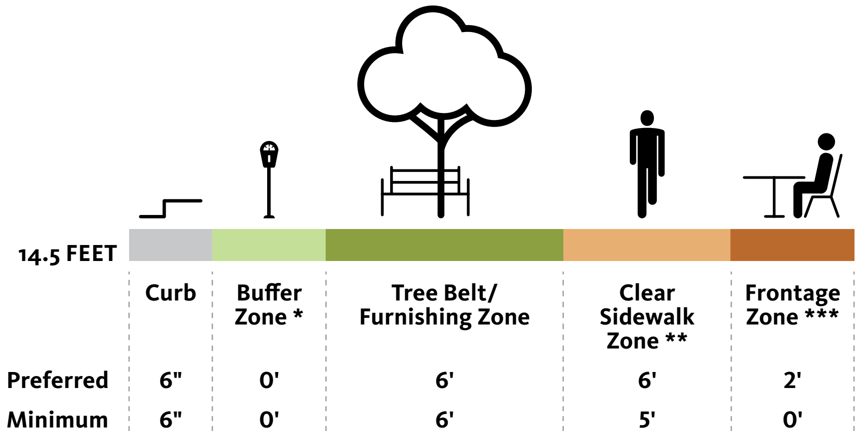
Note: Arrows indicate direction of travel.





Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.



* A 12″ buffer is required in addition to the 6″ curb, in order to meet the 18″ minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12″ of the tree belt.

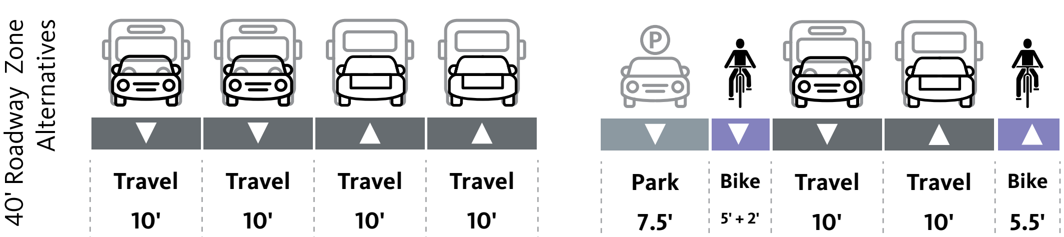
**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

*** Minimum 1' Frontage Zone required next to built structure.

General Notes

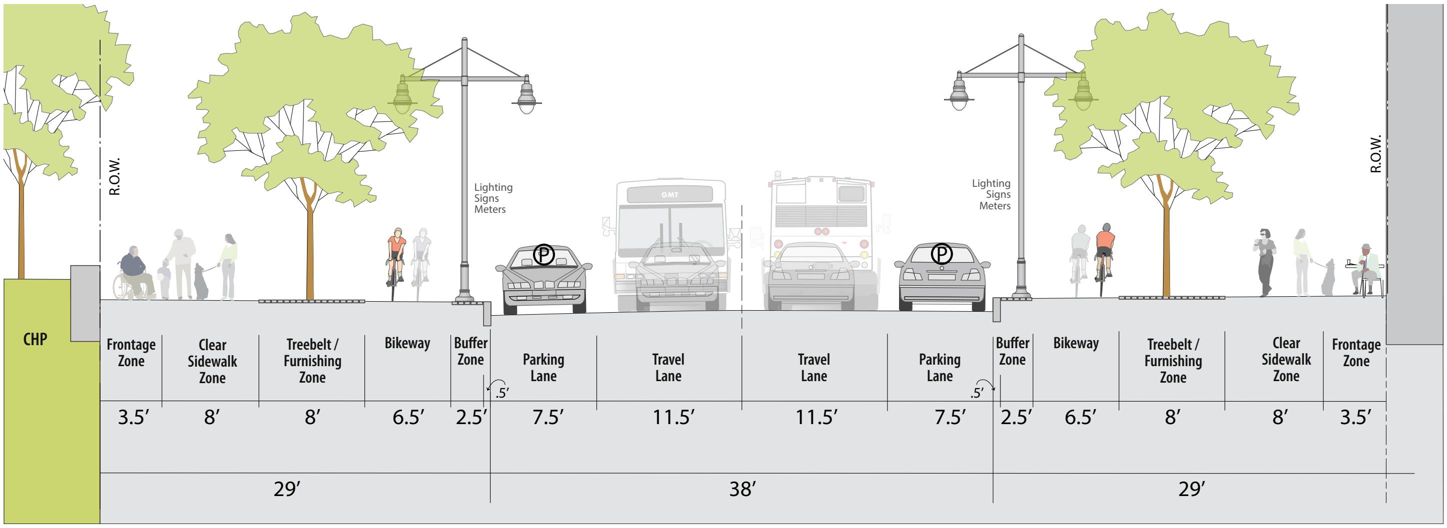
- **Design speed:** ≤ 20 MPH
- **Traffic types:** transit, private vehicle, bike, ped, local deliveries, thru traffic
- **Typical parking type:** parallel
- **Typical bike facility:** separated bike facility per street design considerations
- **Typical travel lane:** 10'–11.5'

40' Roadway Zone Alternative: Pending the outcome of corridor scoping studies for several Major Commercial streets within downtown, it may be necessary to include a Roadway Zone configuration with four travel lanes, or buffered/protected bicycle facilities and parking. For these cases, the Roadway Zone may be widened to 40', which could include the following options:

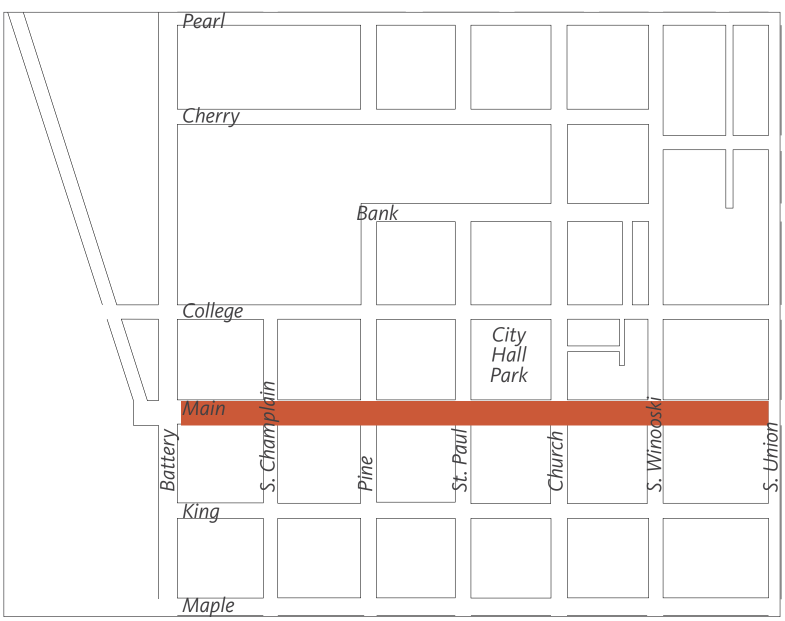


Special Commercial Street (99’ ROW, 38’ Roadway)

38' Roadway Zone—58'+ Pedestrian Zone



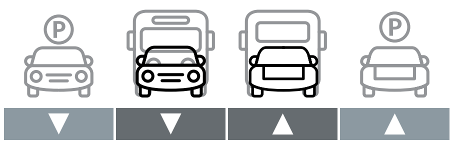
Note: Cross section illustrates Main Street at City Hall Park.



Roadway Zone Options

Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

Note: Arrows indicate direction of travel.



Typical Cross Section	Park	Travel	Travel	Park
	7.5'	11.5'	11.5'	7.5'

Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.

29+ FEET	Curb	Buffer*	Bike	Tree Belt/ Furnishing Zone	Clear Sidewalk Zone **	Frontage Zone ***
Preferred	6"	2.5'	6.5'	8'	8'+	5'
Minimum	6"	2.5'	6.5'	8'	5'	3.5'

* A 12" buffer is required in addition to the 6" curb, in order to meet the 18" minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12" of the tree belt.

**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

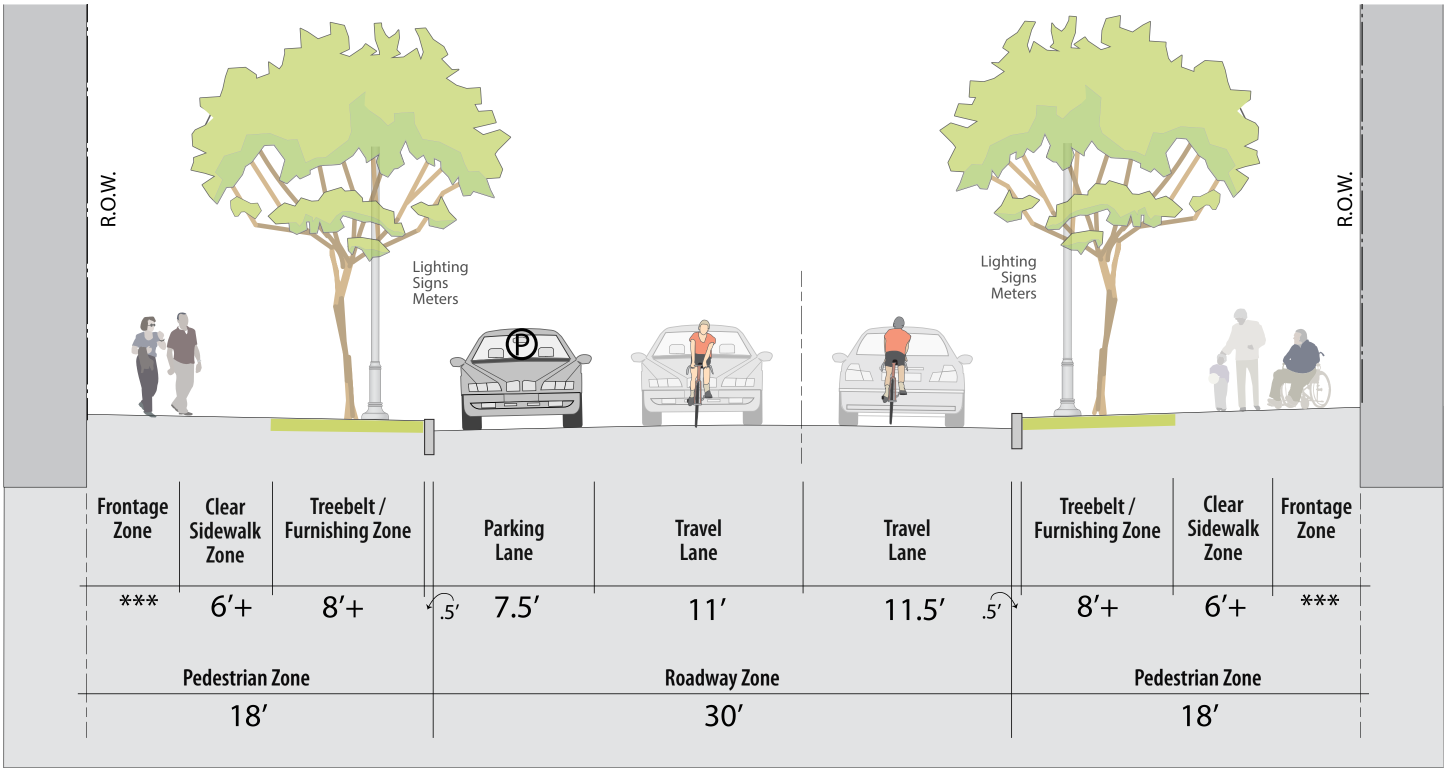
*** Minimum 1' Frontage Zone required next to built structure.

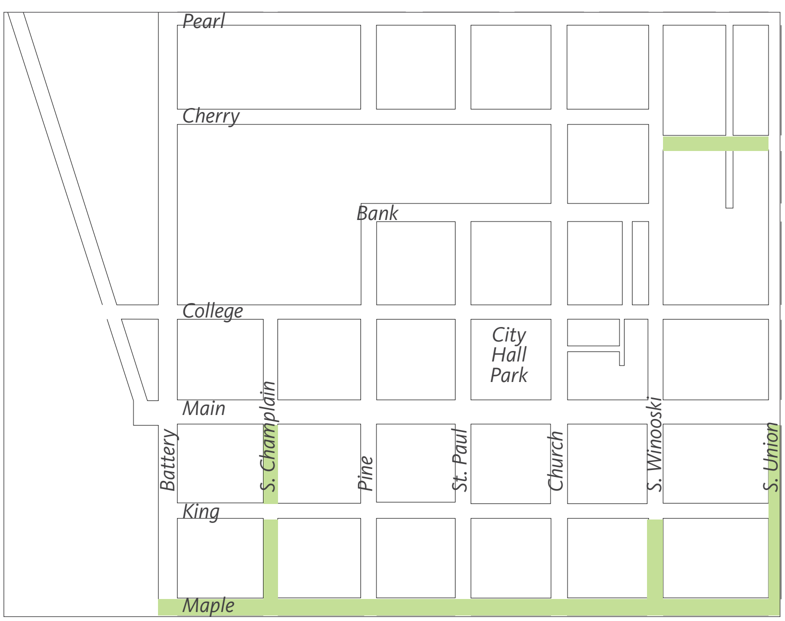
General Notes

- **Design speed:** ≤ 20 MPH
- **Traffic types:** transit, private vehicle, bike, ped, local deliveries, thru traffic.
- **Typical parking type:** parallel
- **Typical bike facility:** raised cycle track
- **Typical travel lane:** 11.5' preferred

Downtown Residential Street (66' ROW, 30' Roadway)

30' Roadway Zone—36' Pedestrian Zone



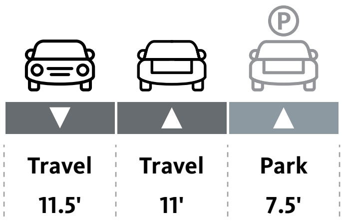


Roadway Zone Options

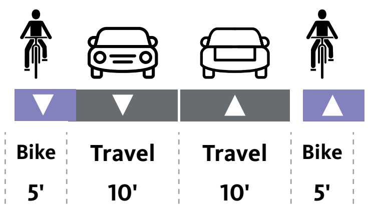
Options for zone arrangements within the roadway based on streets' unique characteristics and identified plans.

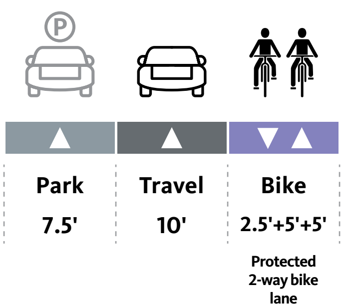
Note: Arrows indicate direction of travel.

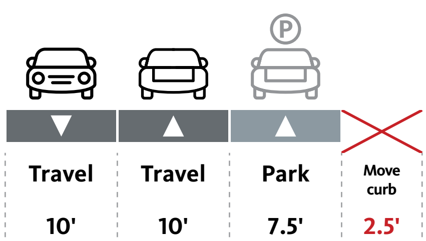
Typical Cross Section



Alternative Options







Pedestrian Zone Options

Options for zone arrangements outside the curb based on streets' unique characteristics and adjacent land uses.

18 FEET	Curb	Buffer Zone *	Tree Belt/ Furnishing Zone	Clear Sidewalk Zone **	Frontage Zone***
Preferred	6"	0'	8'+	6'+	1'
Minimum	6"	0'	6'	5'	1'

* A 12″ buffer is required in addition to the 6″ curb, in order to meet the 18″ minimum setback from curb face to vertical obstructions when adjacent to parking. When there is no buffer zone, no vertical elements can be within the outermost 12″ of the tree belt.

**The Minimum Clear Sidewalk Zone dimension is the most critical dimension to be maintained when the ROW is constrained. In extremely constrained environments, the placement of elements within the Tree Belt/Furnishing Zone may allow for a portion of this zone to be utilized to accomodate the minimum clear sidewalk dimension. ADA minimum walkway standards may be applied only upon approval of the City Engineer.

*** Minimum 1' Frontage Zone required next to built structure. If Frontage Zone is occupied by turf, maintain 1' on back of sidewalk for repairing/replacing sidewalks.

General Notes

- **Design speed:** ≤ 20 MPH
- **Traffic types:** private vehicle, bike, ped, local deliveries, thru traffic, limited transit.
- **Typical parking type:** parallel
- **Typical bike facility:** shared right-of-way, except where noted
- **Typical travel lane:** 11'

Additional Options: See the Stormwater Toolkit for *"Roadway Zone" on page 218* for additional Roadway Zone Options, particularly when the opportunity to reduce the Roadway width is available. (See diagram below.)

Street & Intersection Assemblies

Assembling Great Streets

33% of the land area within downtown Burlington is made up of public rights-of-way. Streets and sidewalks are truly public space. They are the paths that everyone travels, the place in the city where everyone comes together, where people see and talk to each other. The organization and placement of elements within this public space should reinforce these characteristcs and reflect that streets are an important space in the city.

The goal of this section is to illustrate how all streetscape improvements, large or small, contribute to the creation of consistent, vibrant, livable, and walkable streetscapes when placed appropriately. While each streetscape element has its own specific recommendations, this section includes general placement guidelines to ensure a consistent character and quality of streets, especially with regard to the requirements of the Americans with Disabilities Act (ADA).

The illustrations on the following pages should inform the selection of elements that are to be located on commercial or residential streets, and where those elements should appear within the block (mid-block or at an intersection). It should be noted that not every streetscape element is appropriate for every street. Indeed, these elements should be located appropriate to the scale, character, and function of a particular street.

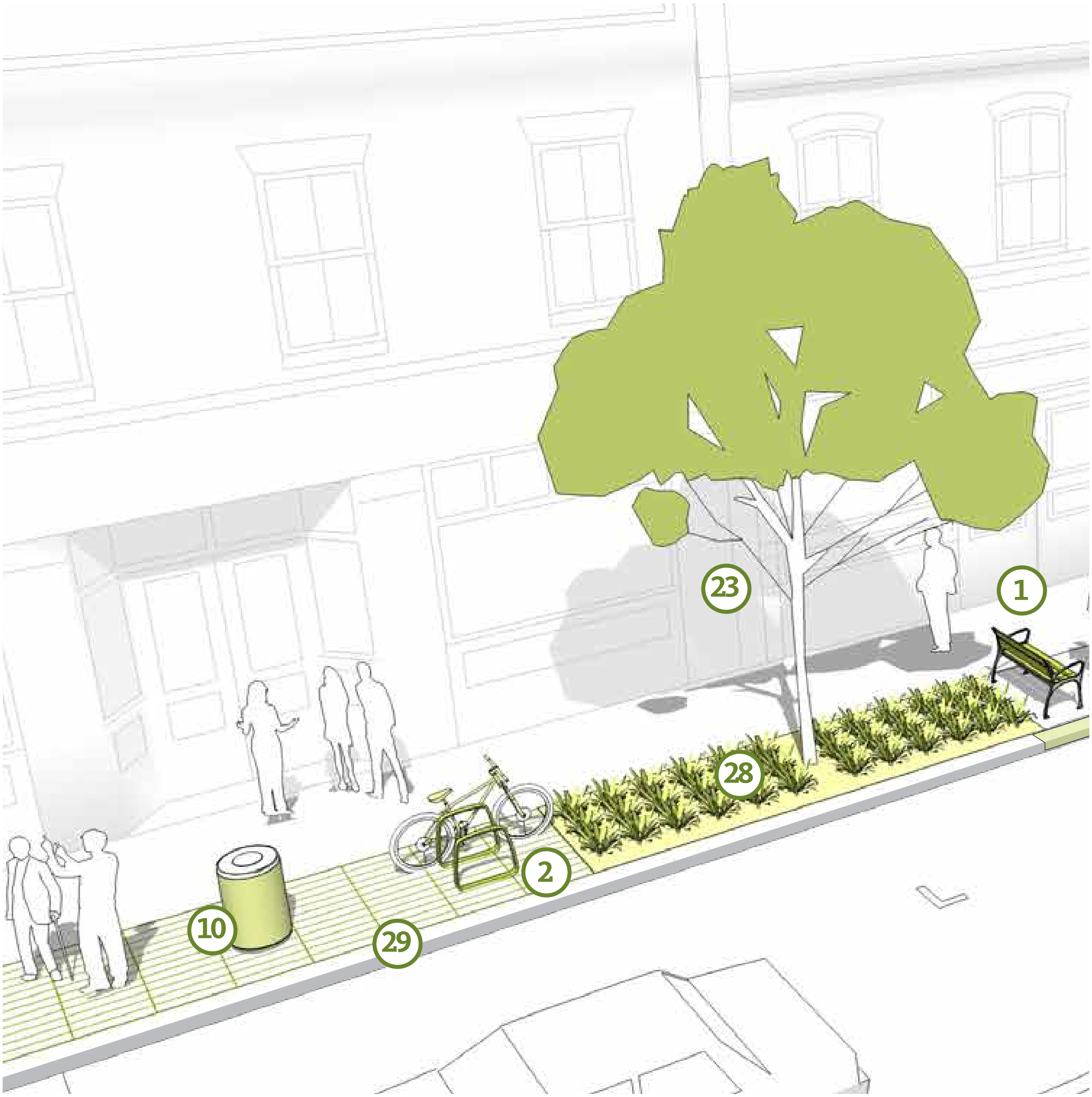
While certain elements, such as paving or tree species, will tend to be applied consistently along a street, others (benches and info kiosks for example) may be applied only in areas with more concentrated pedestrian activity or key destinations. In some cases, custom elements (art driven efforts, for example) may be considered to create a distinctive treatment. Otherwise, the elements specified here provide the flexibility to respond to a range of contexts while ensuring a consistent design vocabulary for downtown.

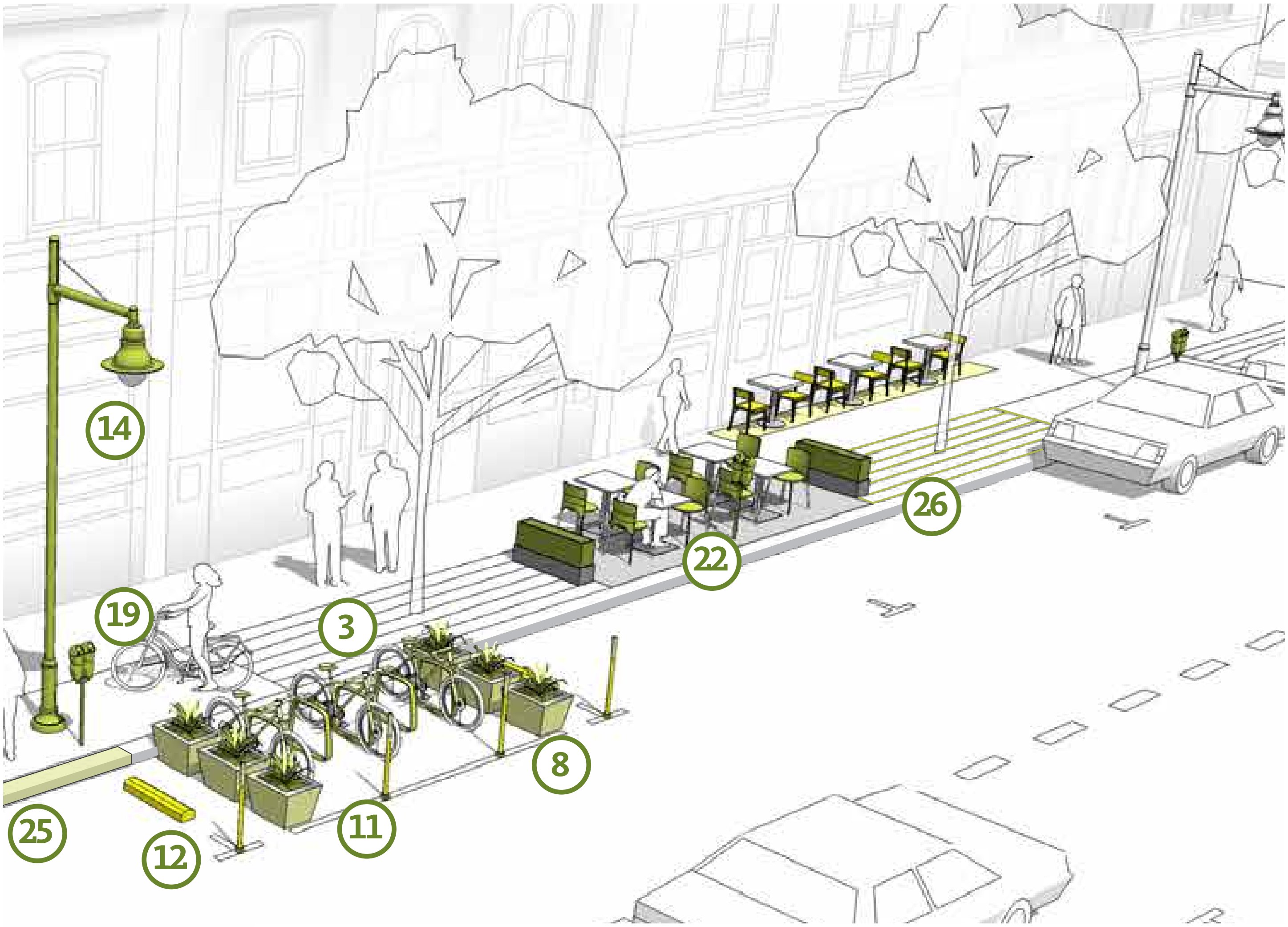
Detailed considerations for placement of these elements within the ROW are located in *"Standard Dimensions & Siting Considerations" on page 96* and should be consulted in conjunction with these illustrations. Specific streetscape standard elements can be found in the *"Materials & Furnishings Palette" on page 269* and in *Appendix section A-8*.

Streetscape on Campus Pkwy. at University of Washington in Seattle, WA. (Photo credit Justin Martin—http://flic.kr/p/rktyLR)

Commercial Street within 66’ ROW

MIDBLOCK ASSEMBLIES



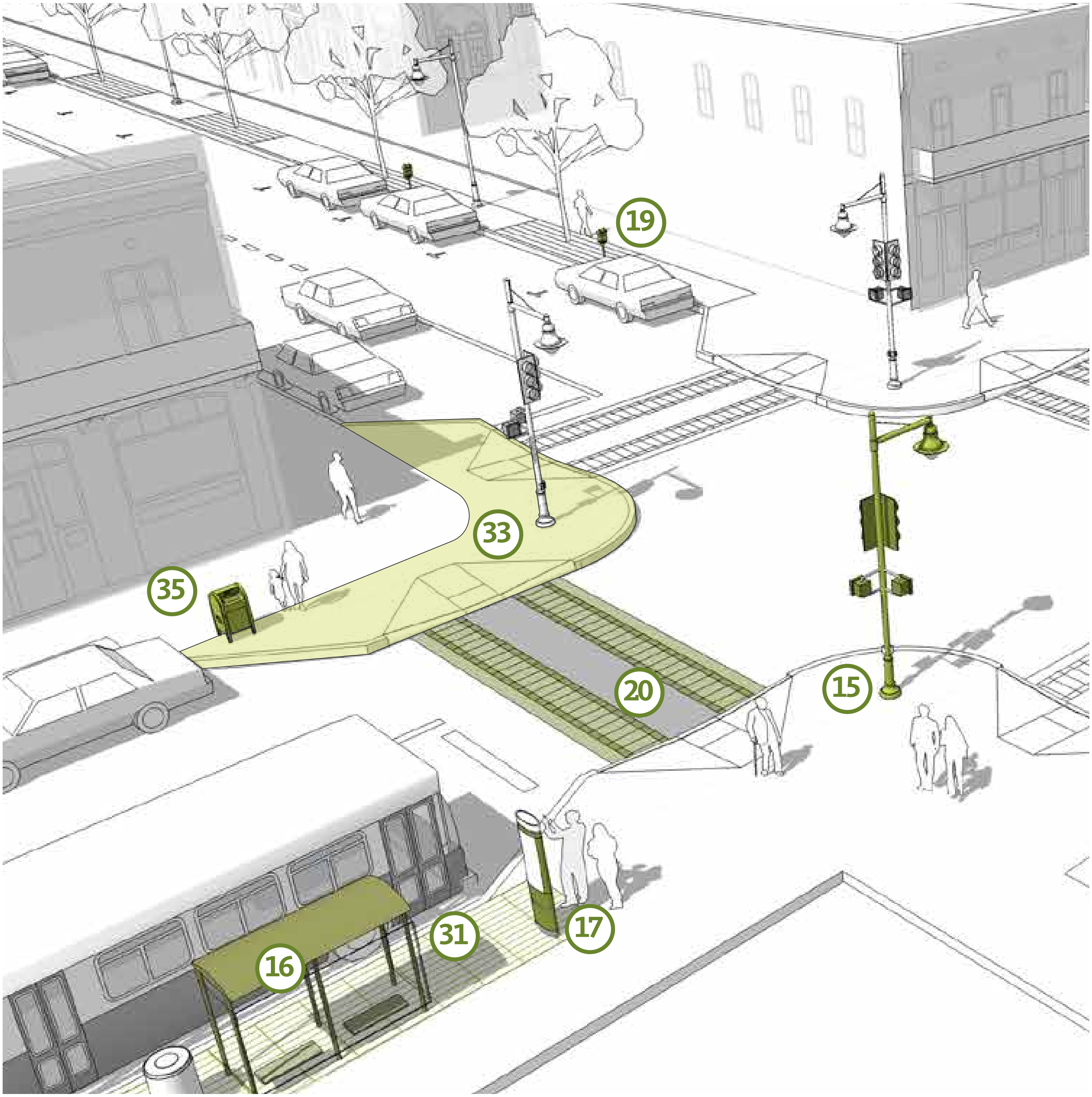


1	*"Benches" on page 288*	**19**	*"Parking Meters" on page 311*
2	*"Bike Rack" on page 294*	**22**	*"Outdoor Dining" page 120*
3	*"High-Capacity Bike Parking" on page 296*	**23**	*"Street Trees" on page 172*
8	*"Planters" on page 301*	**25**	*"Granite Curbs" on page 276*
10	*"Trash/Recycling" on page 303*	**26**	*"Tree well grates & guards" on page 307*
11	*"Safe Hit Posts"page 298*	**28**	*"Tree belt planter" on page 185*
12	*"Wheel Stops" on page 298*	**29**	*"Tree Belt Permeable Pavers" on page 277*
14	*"Street Lights" on page 262*		

Click on these links to navigate directly to details for these elements.

Commercial Street with 66' ROW

CROSS INTERSECTION



1 *"Benches" on page 288*

2 *"Bike Rack" on page 294*

10 *"Trash/Recycling" on page 303*

15 *"Street & Traffic Lighting" on apage 312*

16 *"Bus Shelter" on page 310*

17 *"Map Kiosk" on page 316*

19 *"Parking Meters" on page 311*

20 *"Crosswalks" on page 280*

22 *"Outdoor Dining" page 120*

23 *"Street Trees" on page 172*

25 *"Granite Curbs" on page 276*

31 *"Tree Belt Permeable Pavers" on page 277*

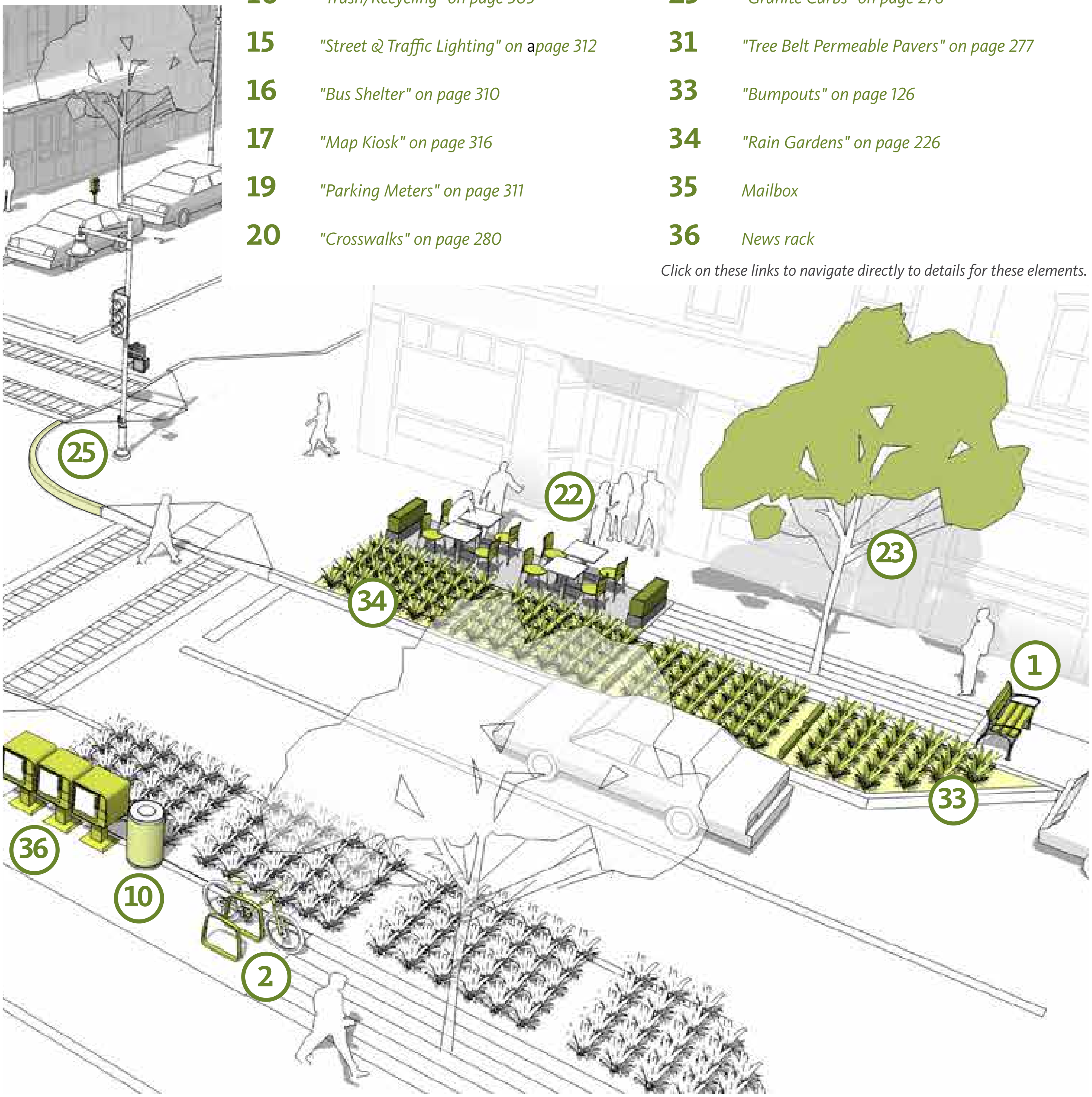
33 *"Bumpouts" on page 126*

34 *"Rain Gardens" on page 226*

35 *Mailbox*

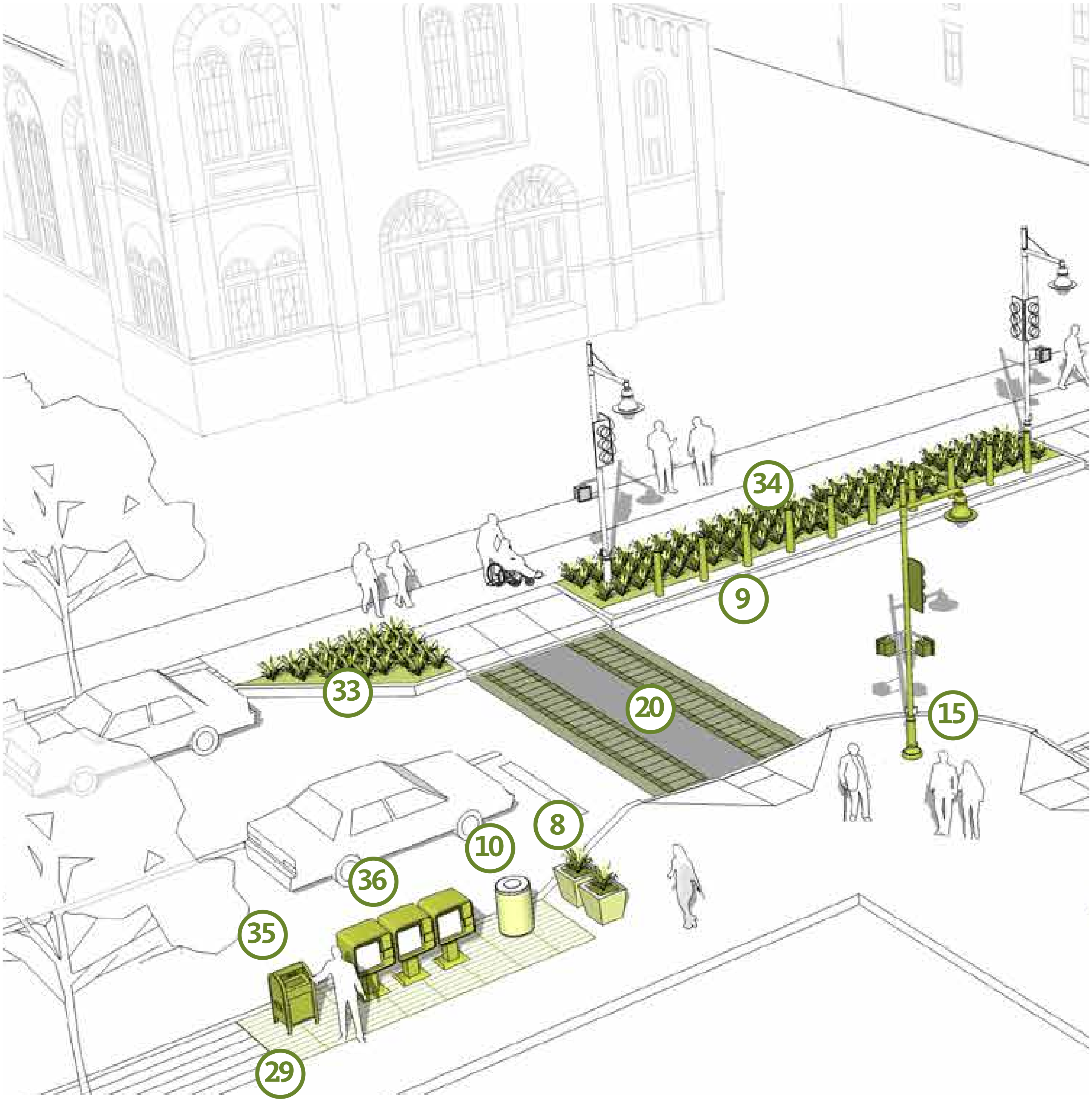
36 *News rack*

Click on these links to navigate directly to details for these elements.



Commercial Streets with 66' ROW

"T" INTERSECTION



1 "Benches" on page 288

2 "Bike Rack" on page 294

8 "Planters" on page 301

9 "Bollard" on page 300

10 "Trash/Recycling" on page 303

15 "Street & Traffic Lighting" on page 312

19 "Parking Meters" on page 311

20 "Crosswalks" on page 280

23 "Street Trees" on page 172

25 "Granite Curbs" on page 276

28 Tree belt planter" page 176

29 "Tree belt pervious pavers" page 277

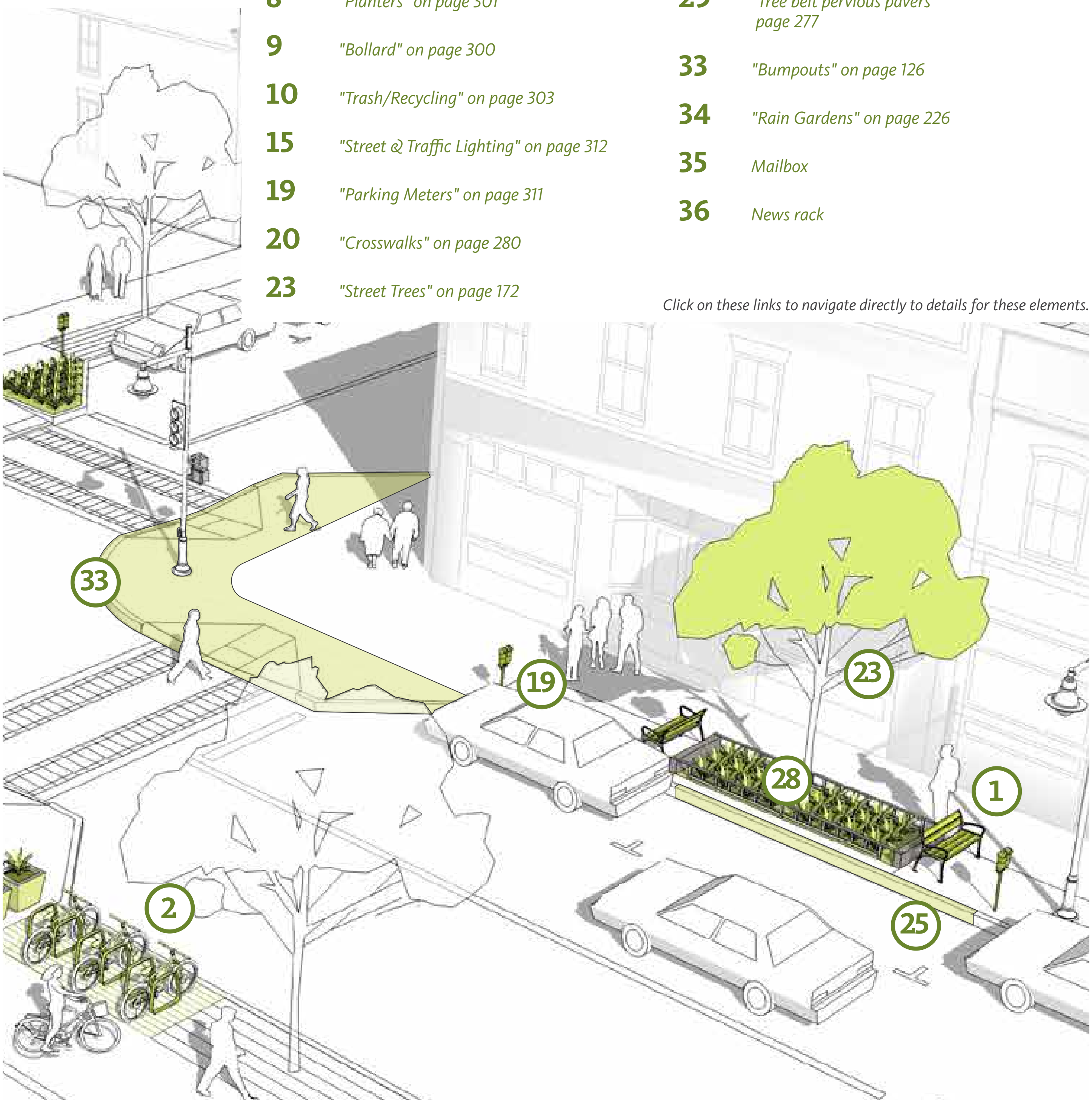
33 "Bumpouts" on page 126

34 "Rain Gardens" on page 226

35 Mailbox

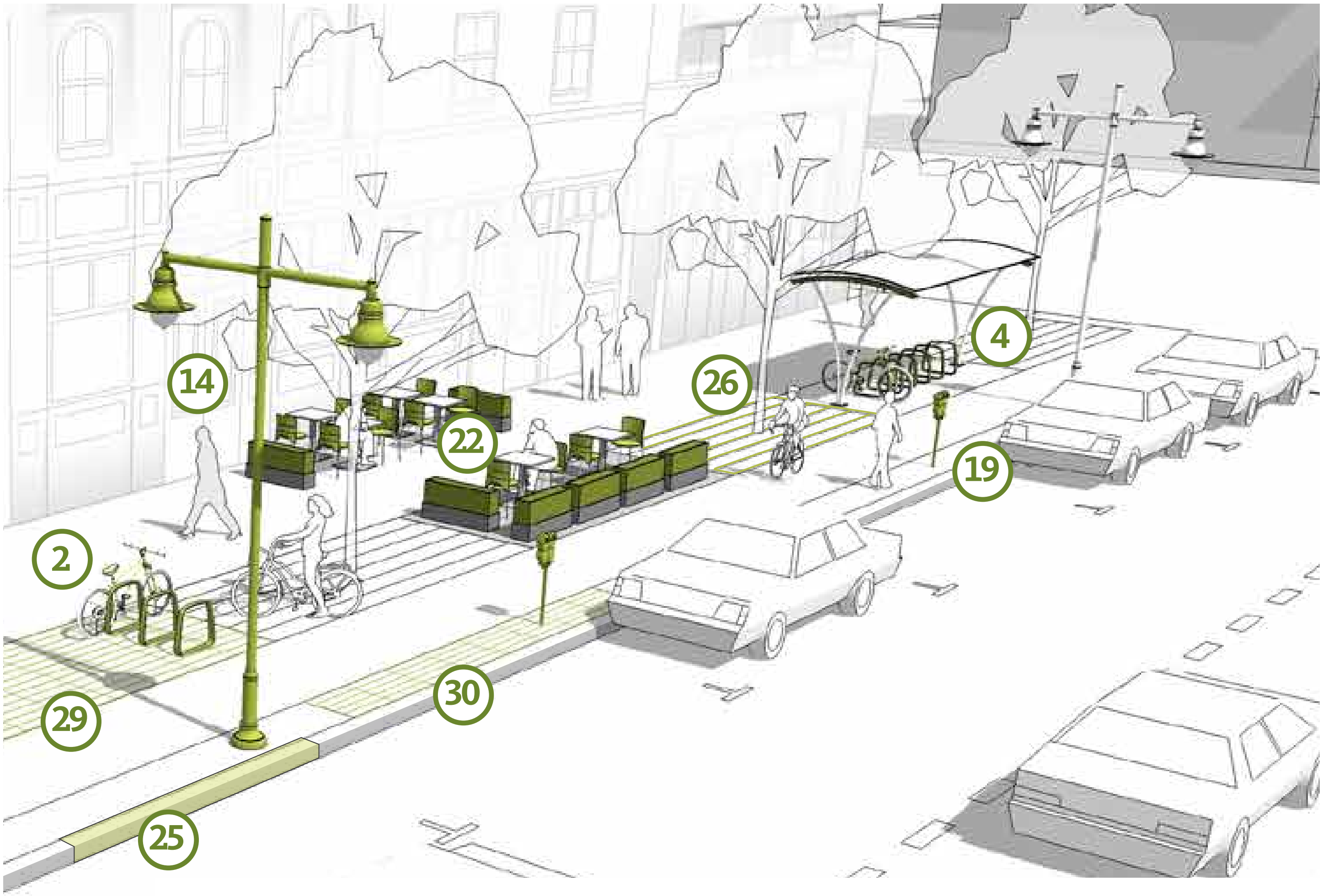
36 News rack

Click on these links to navigate directly to details for these elements.



Commercial Street with 99' ROW

MIDBLOCK

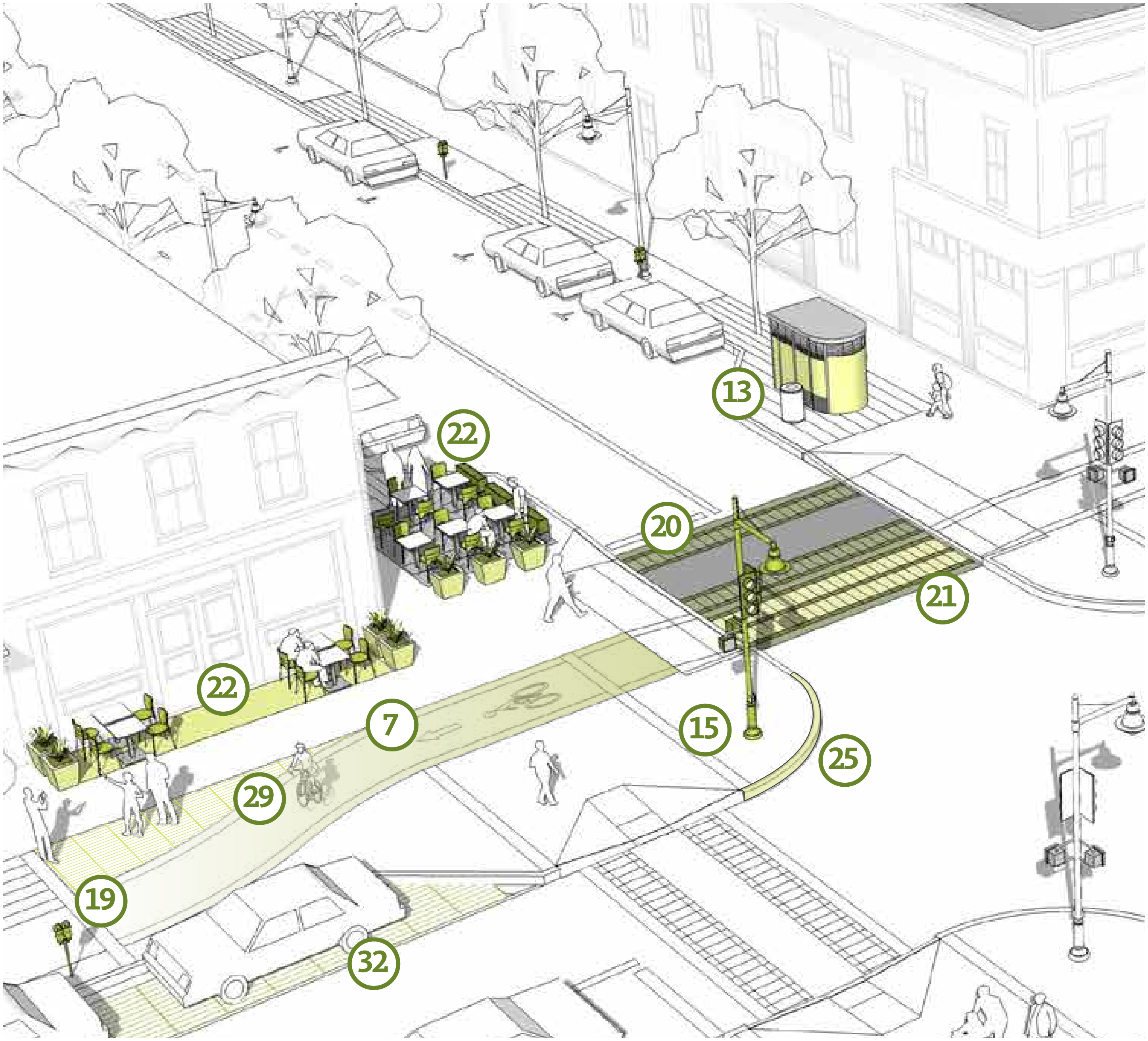


1	*"Benches" on page 288*
2	*"Bike Rack" on page 294*
4	*"Bike Shelter" on page 297*
7	*"Protected Bicycle Lane" on page 145*
8	*"Planters" on page 301*
10	*"Trash/Recycling" on page 303*
14	*"Street Lights" on page 262*
19	*"Parking Meters" on page 311*
22	*"Outdoor Dining" page 120*
23	*"Street Trees" on page 172*
25	*"Granite Curbs" on page 276*
26	*"Tree well grates & guards" on page 307*
28	*"Tree belt planter" page 176*
29	*"Permeable Pavers" on page 277*
30	*"Permeable Pavers" on page 277*
32	*"Parking Lane Permeable Pavers" on page 275*
37	*"Vendor Carts" on page 117*

Click on these links to navigate directly to details for these elements.

Commercial Street with 99’ ROW

CROSS INTERSECTION



1 "Benches" on page 288

2 "Bike Rack" on page 294

7

8 "Planters" on page 301

10 "Trash/Recycling" on page 303

13 "Public Toilets" on page 305

14 "Street Lights" on page 262

15 "Street & Traffic Lighting" on page 312

17 "Map Kiosk" on page 316

19 "Parking Meters" on page 311

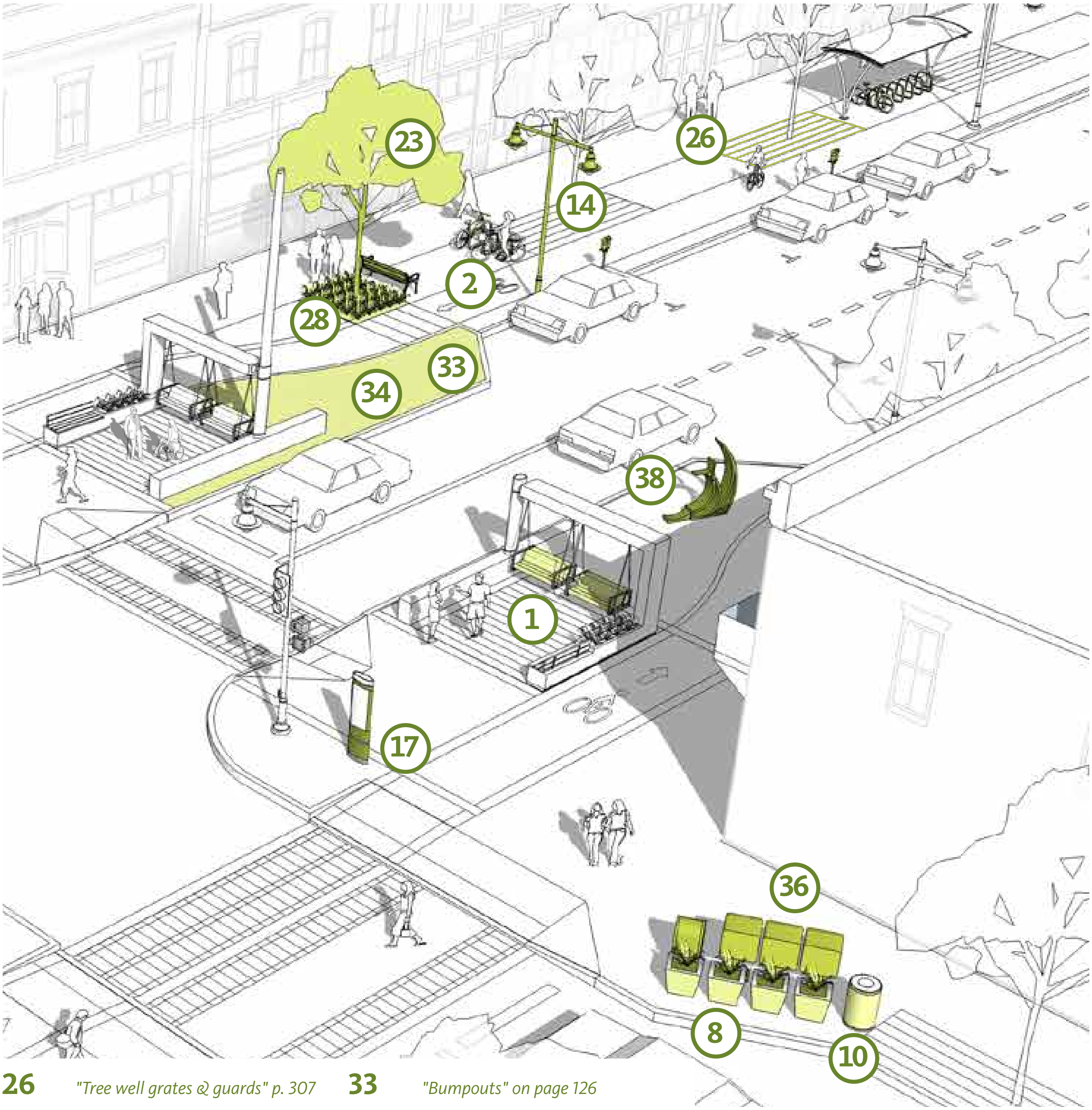
20 "Crosswalks" on page 280

21 "BIke Crossking" on page 149

22 "Outdoor Dining" page 120

23 "Street Trees" on page 172

25 "Granite Curbs" on page 276



26 *"Tree well grates & guards" p. 307*

28 *"Tree belt planter" page 186*

29 *"Tree belt Permeable Pavers" p. 277*

32 *"Parking Lane Permeable Pavers" on page 275*

33 *"Bumpouts" on page 126*

34 *"Rain Gardens" on page 226*

36 *"Newsrack" on page 304*

Click on these links to navigate directly to details for these elements.

Residential Streets with 66’ ROW

MIDBLOCK

5 *"Bike Lane" on page 142*

6 *"Shared Lane" on page 141*

14 *"Street Lights" on page 262*

23 *"Street Trees" on page 172*

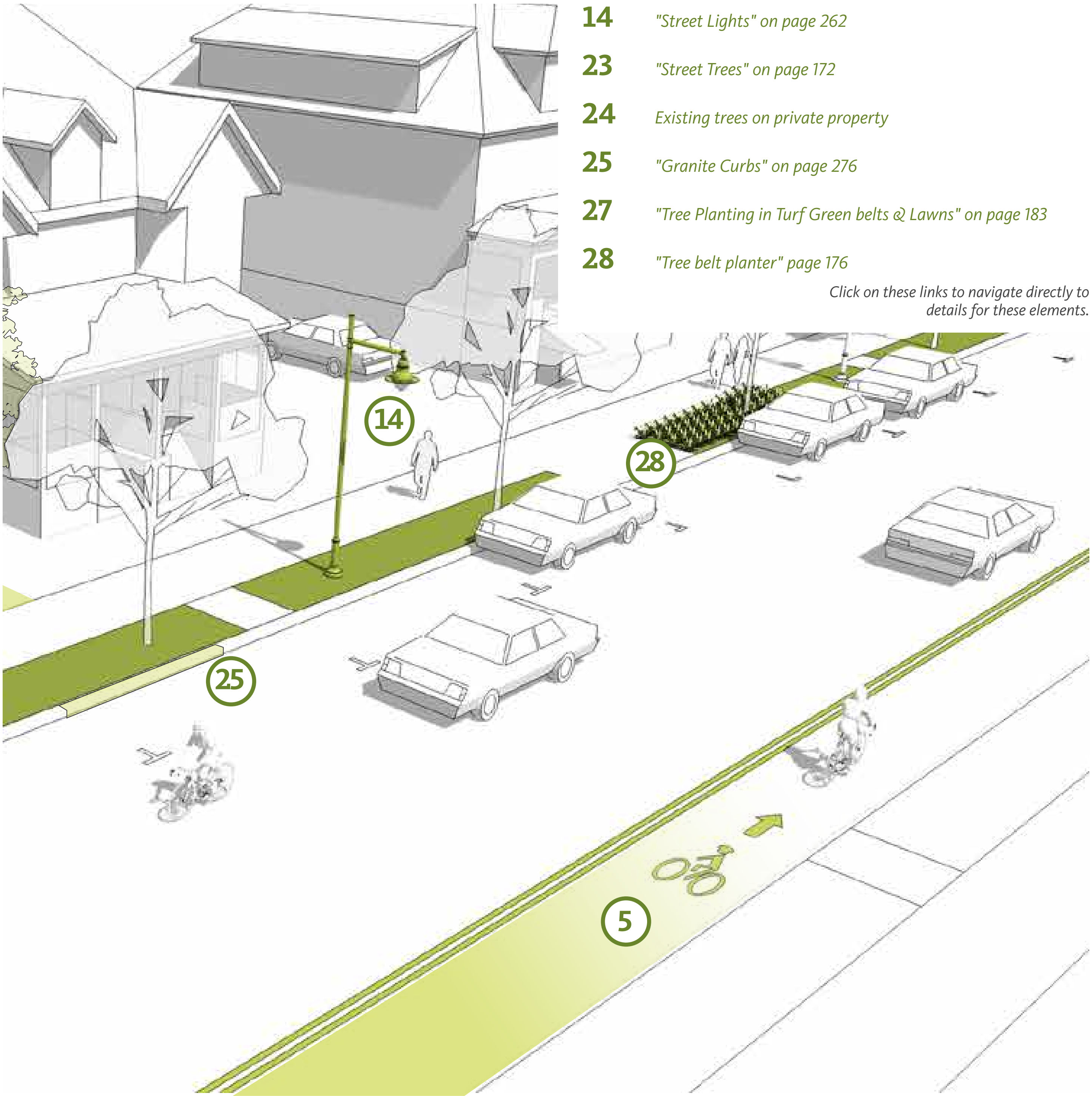
24 *Existing trees on private property*

25 *"Granite Curbs" on page 276*

27 *"Tree Planting in Turf Green belts & Lawns" on page 183*

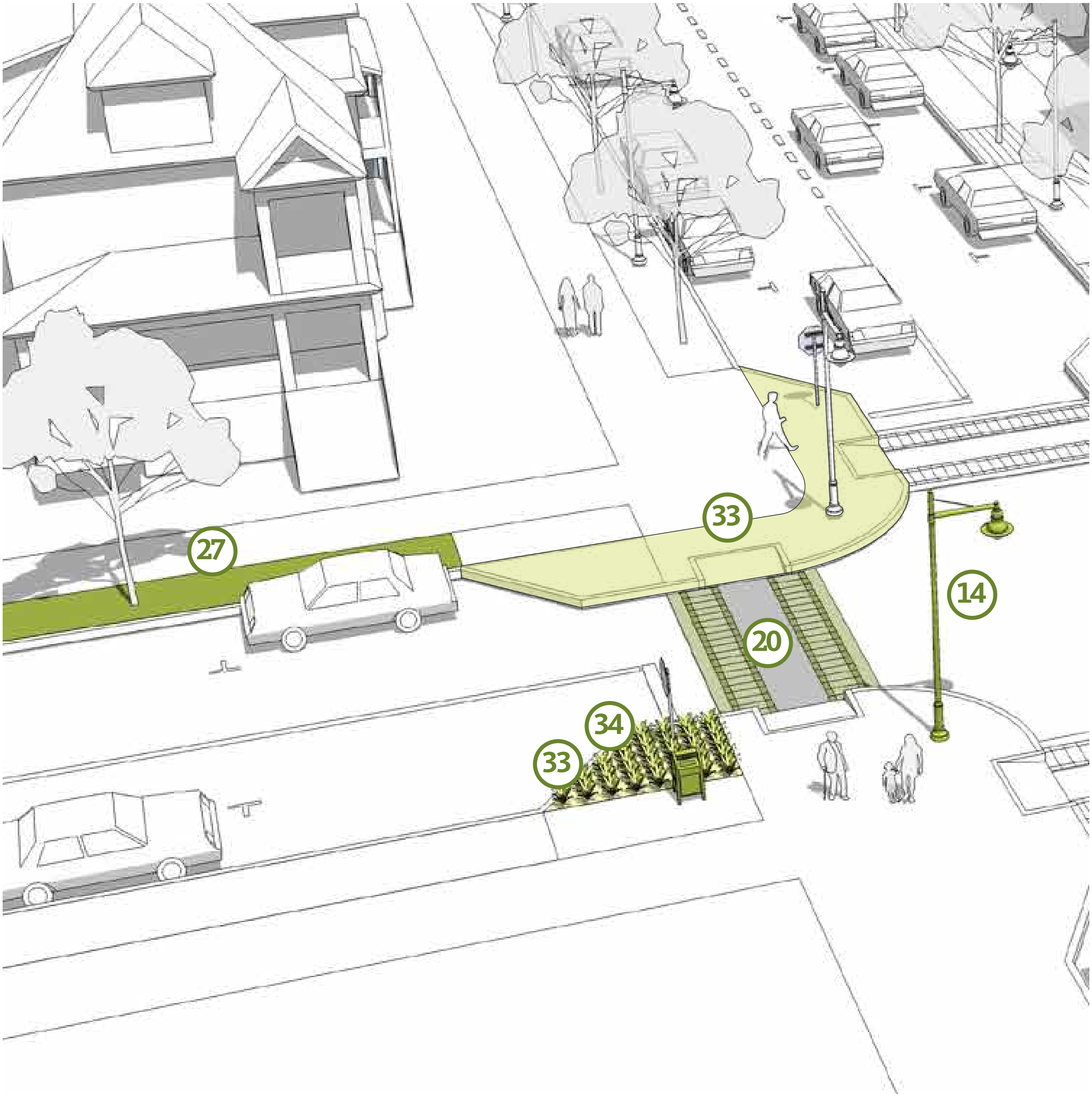
28 *"Tree belt planter" page 176*

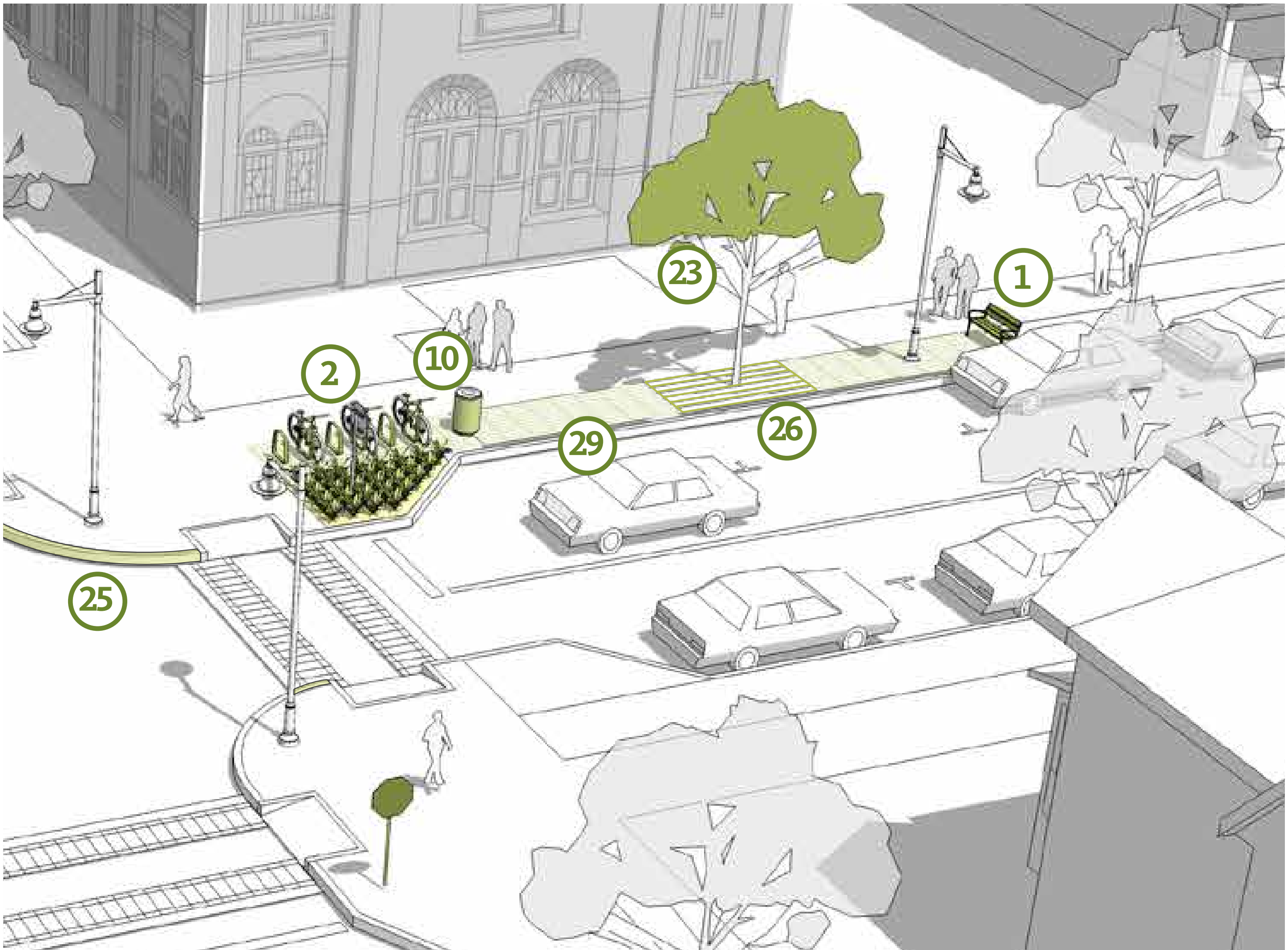
Click on these links to navigate directly to details for these elements.



Residential Streets with 66’ ROW

CROSS INTERSECTION





1 "Benches" on page 288

2 "Bike Rack" on page 294

10 "Trash/Recycling" on page 303

14 "Street Lights" on page 262

20 "Crosswalks" on page 280

23 "Street Trees" on page 172

25 "Granite Curbs" on page 276

26 "Tree well grates & guards" on page 307

27 "Tree Planting in Turf Green belts & Lawns" on page 183

29 "Tree Belt Permeable Pavers" on page 277

33 "Bumpouts" on page 126

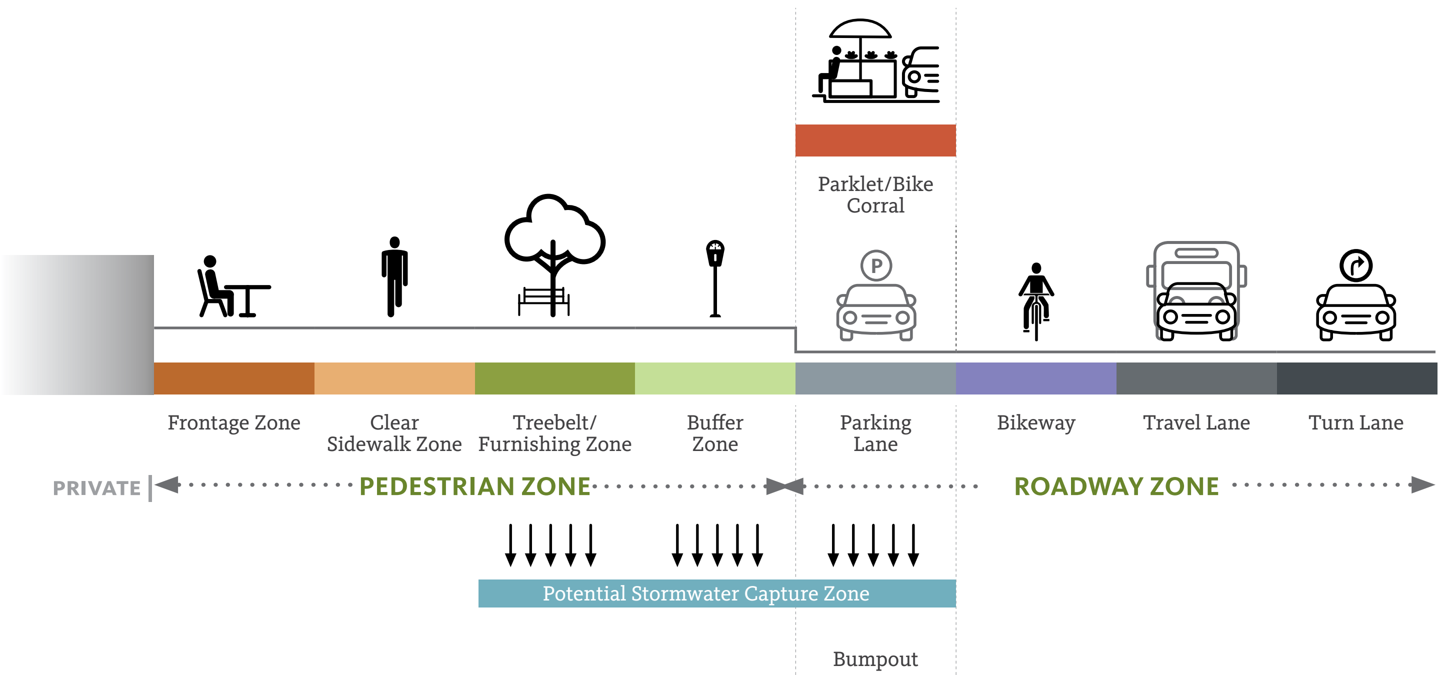
34 "Rain Gardens" on page 226

Click on these links to navigate directly to details for these elements.

Standard Dimensions & Siting Considerations

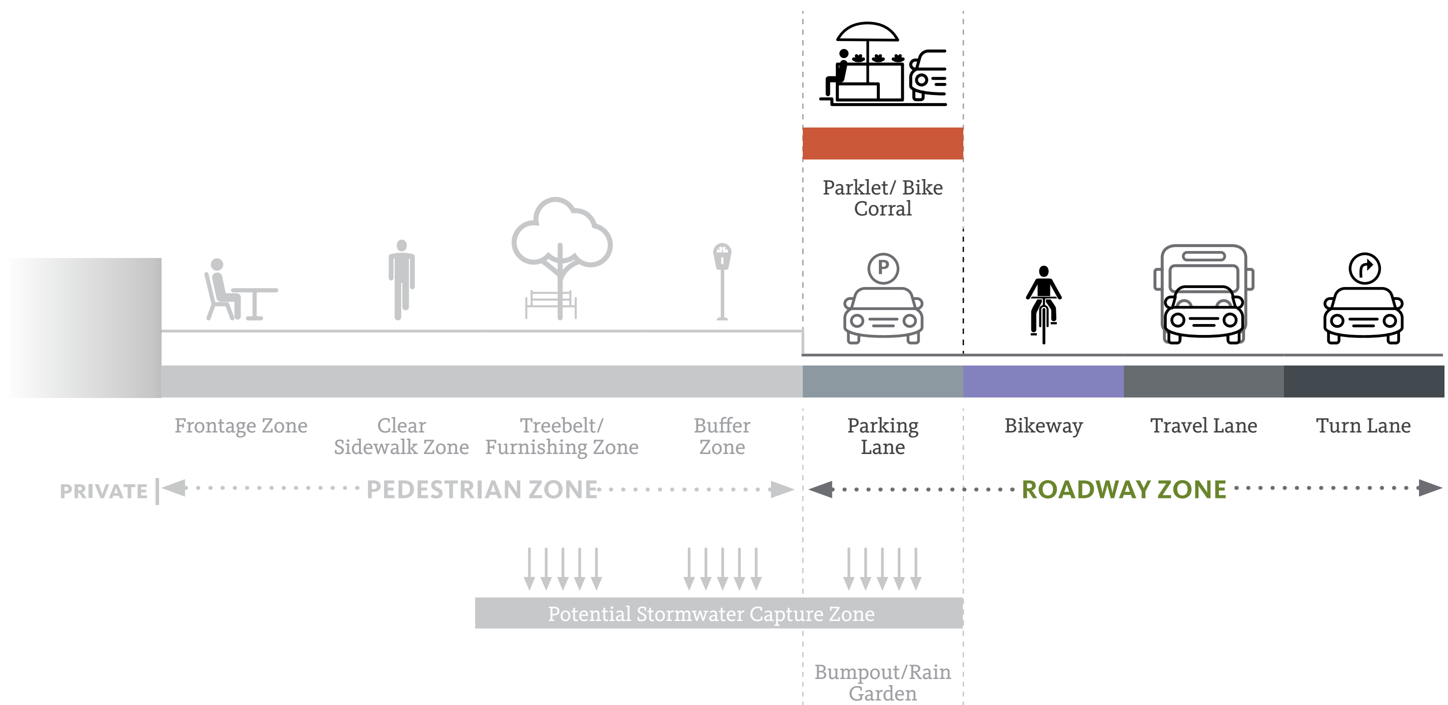
Standards for Laneways and Elements

This section provides the requirements for dimensions and siting of elements within the downtown rights-of-way. This includes minimum, maximum, and/or preferred dimensions for zones located within the Roadway and Pedestrian Zones, requirements for carrying these zones through intersections, and separation and placement requirements for individual elements within the right-of-way. This section should be consulted after the Street Type and Roadway and Pedestrian Zone options have been selected for a project to ensure that all applicable local, state and federal standards are met. Additionally, this section should inform the "fit up" of the streetscape as individual elements are selected and located in the design process.



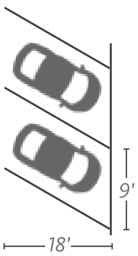
Roadway Zones

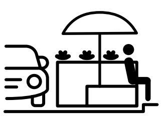
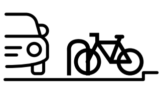
This zone is dedicated primarily to th emovement of personal, delivery, and transit vehicles and bicycles in a way that is physically separated from pedestrians. The following Roadway Zone standard dimensions are critical to ensuring that the City is meeting all state and federal requirements for vehicular transportation routes, and appropriately designing streets to meet current and anticipated traffic volumes, types, speed, and design speed. While the street design hierarchy prioritizes pedestrians, the dimensions begin with roadway zones because these lanes have the least flexibility in order to meet minimum spacing requirements.



Zone	Dimensions	Considerations	Add'l Info

Parking Lane


 	
	Parallel Parking:
	7.5' x 20'
	
	Angled Parking:
	9' x 18' (length measured perpendicular to curb when stall is at 60 deg. angle)
		• Per City Ordinance, no parking is permitted within 50' of the corner of an intersection, unless determined by a professional engineer that sight triangles for both vehicles and pedestrians can be maintained, then the 50' may be reduced, but at no time shall be less than:
		  ◦ A 20' minimum no parking zone should be established from a crosswalk to the first parking stall at uncontrolled intersections where no bumpout exists for the crosswalk, or on the uncontrolled street of a signalized intersection with a flashing operation.
		  ◦ A 10' minimum no parking zone should be established from a crosswalk to the first parking stall at uncontrolled intersections when the crosswalk is protect by a bumpout, on the minor street of a stop controlled intersection or signalized intersection with a flashing operation, and at a multi-way stop controll intersection.
		• Motorcycle and scooter parking may be located at the end of a block where the size and profile allows site distances to be maintained.
		• It is recommended to utilize parallel parking where on-street parking is included within a street's design; however, if angled parking is determined to be most suitable for a street's design goals, that parking should meet the 60 deg. angle dimensions.
		
		VTrans ref. dwg. Standard E-193 Pavement Marking Details Parking Stall Markings Section 3B.19
			App. A-1

Parking Zone Placemaking Options  	6' x 12' (1 parking stall) 6' x 32' (2 parking stalls)	• Parklets and bike corrals shall be immovable once placed, but capable of being removed and stored during winter months or when required by request of City. • Parklets are permitted on streets with design speeds of 20 MPH or less per the guidance on *page 127*. Greater separation and/or more intensive buffer elements may be requried by the City Engineer for streets with high traffic volumes or high volumes of heavy vehicles. • In general, parklets should be located at least one parking space away from an intersection or street corner, 4' from an adjacent parking stall, and 1'-2' from an adjacent travel lane. • Parklets and bike corrals are sited along the curb line on streets where on-street parking spaces exist. They can be considered in any location where there are or would be space(s) for on-street parallel or angled parking, except for where accessible spaces are provided. • Parklets are not permitted along the curb in areas where bus stops or bus pull-offs are located. • Parklets may not be constructed over utility access panels, manhole covers, storm drains, or fire hydrant shut-off valves. • Bike Corrals can be considered when Pedestrian Zone space is limited and should be dedicated toother pedestrian uses, or where bike parking demand is very high.	*page 127*

Zone	Dimensions	Considerations	Add'l Info
Bikeway		**Shared Lane** **Conventional Lane Adjacent to Curb** **Buffered Lane Adjacent to Curb** **Buffered Lane Adjacent to Parking** **Protected Bicycle Lane** **Contra-Flow Lane** **Advisory Lane** **VTrans ref. dwg. Standard E-131B Bicycle Guide Sign Details** **VTrans ref. dwg. Standard E-194 Bicycle Pavement Markings and Sign Layout**	*page 141* *page 142* *page 143* *page 144* *page 145* *page 146* *page 147* *App. A-5* *App. A-5*
Travel Lane	10' minimum; 10.5' minimum on transit/truck routes	• Wider travel lanes (11' to 12') are appropriate in locations with high volumes of heavy vehicles. • Travel lane widths of 10' generally provide adequate safety in urban settings while discouraging speeding. City may choose to use 11' lanes (10.5' min.) on designated truck and bus routes. **VTrans ref. dwg. Standard E-193 Pavement Marking Details**	 *App. A-1*
Turn Lane	9.5' min. 10' min. on Transit/Truck Routes	• Assess left-turn volumes and evaluate the overall traffic network to determine whether or not left turns can be restricted or removed at a particular intersection. **VTrans ref. dwg. Standard E-191 Pavement Marking Details** **VTrans ref. dwg. Standard E-192 Pavement Marking Details**	 *App. A-1*
Bus Berth	10' min.	Bus berths consist of an entrance taper, a deceleration zone, a stopping zone, an acceleration zone, and an exit taper. They require the curb to be setback from the travel lane to bring the bus out of the flow of traffic. Bus berths work best in conjunction with streets with parking lanes, which in Burlington are typically 7.5' in width. The minimum berth width is 10', thus requiring the need to encroach on the treebelt/furnishing zone in order to accomodate the difference. **Advantages**: • Allows traffic to proceed around the bus, reducing delay for general traffic • Maximizes vehicular capacity of roads • Clearly defines the bus stop • Passenger loading and unloading can be conducted in a more relaxed manner • Eliminates potential rear-end accidents **Disadvantages**: • More difficult to re-enter traffic, increasing bus delay and increasing average travel time for buses • In the presence of bicycle lanes, bus berths pose a potential conflict between buses and bicyclists when the bus needs to cross the bicycle lanes • Uses additional space and may require right-of-way acquisition	

Pedestrian Zones

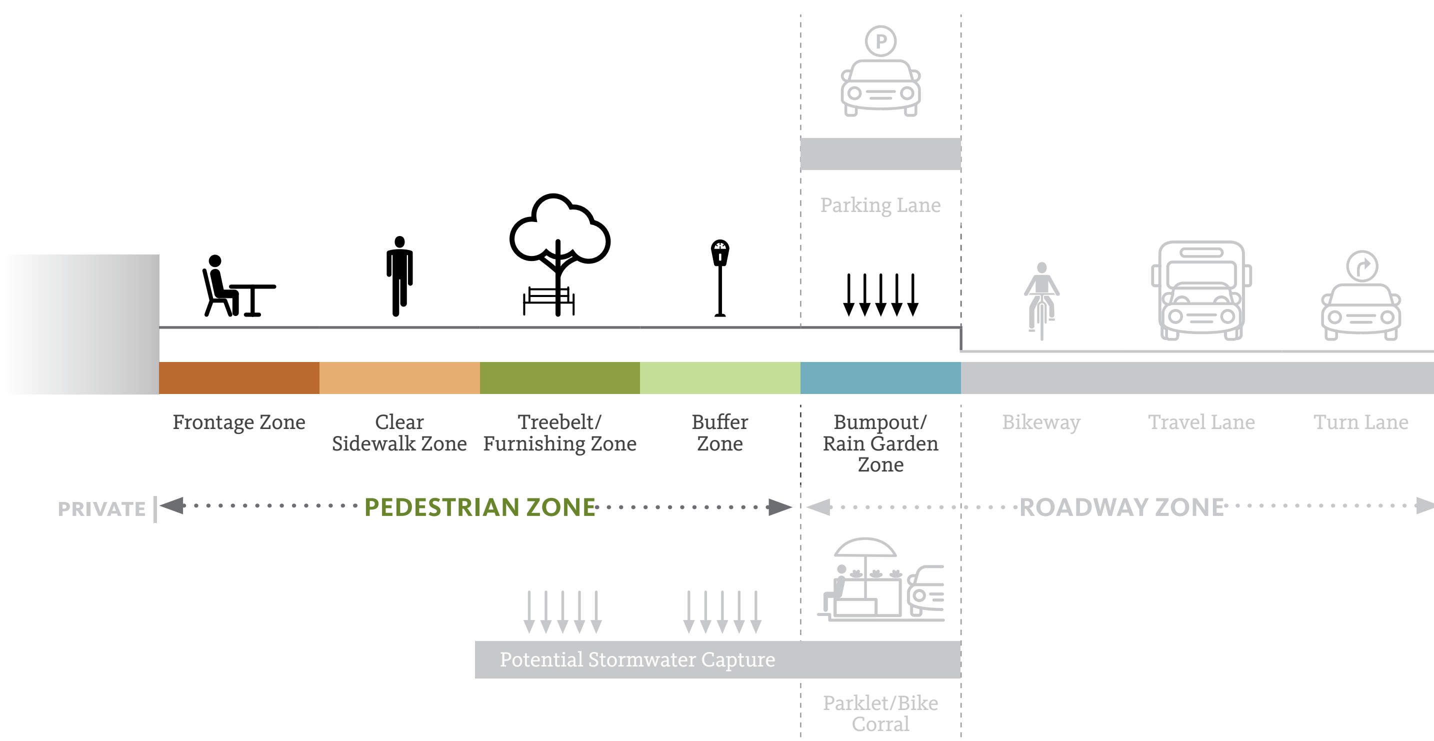
This zone is where all activities aside from driving and parking occur; in addition to unobstructed space for pedestrians to walk, this includes space for street trees and stormwater infrastructure, benches, lighting, mailboxes, and other furnishings, and in some cases, outdoor seating or dining for private uses along a street. The width of the Pedestrian Zone is essential to the degree of comfort, enjoyment, and accesibility of walking along a street. Narrow sidewalks do not support lively pedestrian activity, and may create dangerous conditions that cause people walk in the street. Therefore, the Clear Sidewalk Zone is the most critical element within the Pedestrian Zone; the minimum dimension should always be maintained and may require flexible sizing or elimination of other zones.

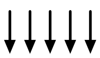
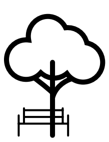
Typically, a five foot wide Sidewalk Zone supports two people walking side by side or two wheel chairs passing each other. An eight foot wide Sidewalk Zone allows two pairs of people to comfortably pass each other, and a ten foot or wider Sidewalk Zone can support high volumes of pedestrians. There may be corridors with high volumes of pedestrian activity for which a pedestrian level of service study would be helpful to determine sidewalk widths that adequately support pedestrians.

Vibrant sidewalks bustling with pedestrian activity are not only used for transportation, but for social walking, lingering, window-shopping, and people watching. Sidewalks, especially along Downtown Commercial, Downtown Mixed-Use, and Neighborhood Main Streets, should encourage social uses of the sidewalk realm by providing adequate widths.

When determining Sidewalk Zone widths, factors to consider include the available right-of-way, accessibility, anticipated pedestrian volumes, ridership projections for locations near transit, and the locations of bus shelters and transfer points. While these guidelines prescribe more generous preferred Clear Sidewalk Zone widths, they also establish a total minimum sidewalk width of 5' for all Street Types.

Widening sidewalks by a few feet is often cost prohibitive and may require significant changes to drainage infrastructure as well as the relocation of utilities. If feasible to adjust curb locations, the widening of sidewalks may be achieved by narrowing and/or removing travel or parking lanes, or establishing setbacks as a part of adjacent private redevelopments. Where setbacks cannot be established or roadway space cannot be reallocated, consider converting the roadway to a Shared Street to increase pedestrian space and reduce vehicle speeds.



Zone	Dimensions	Considerations	Add'l Info
Curb 	**Granite** 6" wide 17" min./19" max. total slab height 6" vertical reveal **Concrete** 6" wide top 9" wide base 18" total slab height 6" vertical reveal	Granite and concrete curb comparison The Curb Zone should be free from all objects, furniture, sign posts, etc. See ref. dwg. **VTrans Standard C-10 Curbing**	*page 276* *App. A-2*
Stormwater/ Rain Garden Zone 		See chapter on *"Stormwater"*	*page 215*
Buffer Zone 	18" minimum next to parked cars 2' minimum next to bicycle facility	• An 18" minimum setback is required for vertical elements adjacent to parking. With a 6" curb, this means a minimum 12" buffer is required next to parking. • Bicycle parking must be 24" from a curb. • On roadways without on-street parking and/or higher speeds, setbacks for vertical elements should be greater than 18" where feasible.	
Tree Belt/ Furnishing Zone 	6' minimum 8' preferred	Maximize the Tree Belt/Furnishing Zone to provide as much of a buffer as possible between the Sidewalk Zone and adjacent street traffic; however do not reduce the Clear Sidewalk Zone beyond the minimum recommended widths. When space is limited at the surface, resulting in a Tree Belt/Furnishing Zone of less than 8', the soil volume for trees can be achieved by encroaching under the Buffer Zone, Clear Sidewalk Zone, and, if applicable, Raised Cycle Track. For new developments and where opportunities are available to create a consistent setback, designs should accommodate wider sidewalks with generous Tree Belt/Furnishing Zones. Consider traffic calming elements, such as curb extensions or chicanes where on-street parking is present, to provide more space for street furniture, trees, and other amenities.	*page 173*

Zone	Dimensions	Considerations	Add'l Info
Clear Sidewalk Zone	5' width minimum Preferred with varies by street type; see street types Slab thickness: 5″ residential 8″ commercial Compressive Strength: 4000 PSI	The Sidewalk Zone should be clear of any obstructions including utilities, traffic control devices, trees, and furniture. While these guidelines prescribe more generous preferred Sidewalk Zone widths, they also establish a **total minimum sidewalk width of 5'** for all Street Types. The ADA minimum walkway width is 4', with a 5' width every 200'; this may be applied when severe dimensional constraints exist upon approval of the City Engineer. When reconstructing sidewalks and relocating utilities, all utility access points and obstructions should be relocated outside of the Clear Sidewalk Zone. Residential driveways are defined as serving single-family, duplex, or three unit structures. Commercial driveways include residential properties with more than three units, as well as mixed use and commercial properties. **VTrans ref. dwg. Standard C-2A Portland Cement Concrete Sidewalk Drive Entrances With Sidewalk Adjacent Curb** **VTrans ref. dwg. Standard C-2B Portland Cement Concrete Sidewalk Drive Entrances With Sidewalk And Green Strip**	*App. A-2*
Frontage Zone	Not required; preferred widths based on adjacent use: • 0'–1' width where building or fence setbacks are required by building code. • 1.5' min. where retail and hospitality uses are encouraged. • 3.5' min. where outdoor seating and display are anticipated/ encouraged. See Preferred width for each street type.	The Frontage Zone is the area between the Clear Sidewalk Zone and either the front wall of an adjacent building, or the edge of a right-of-way. It is where people window shop, enter and exit buildings, or sit and gather at outdoor cafés/restaurants. It also provides a buffer from a building facade that is built to a Frontage Line, so that pedestrians do not have to walk with their shoulders pressed against a building. The ideal dimension for a successful frontage zone is 3.5'. This Zone should be maximized to provide space for cafés, plazas, and greenscape elements along building facades wherever possible, but not at the expense of reducing the Clear Sidewalk Zone below the minimum widths.	*page 124*

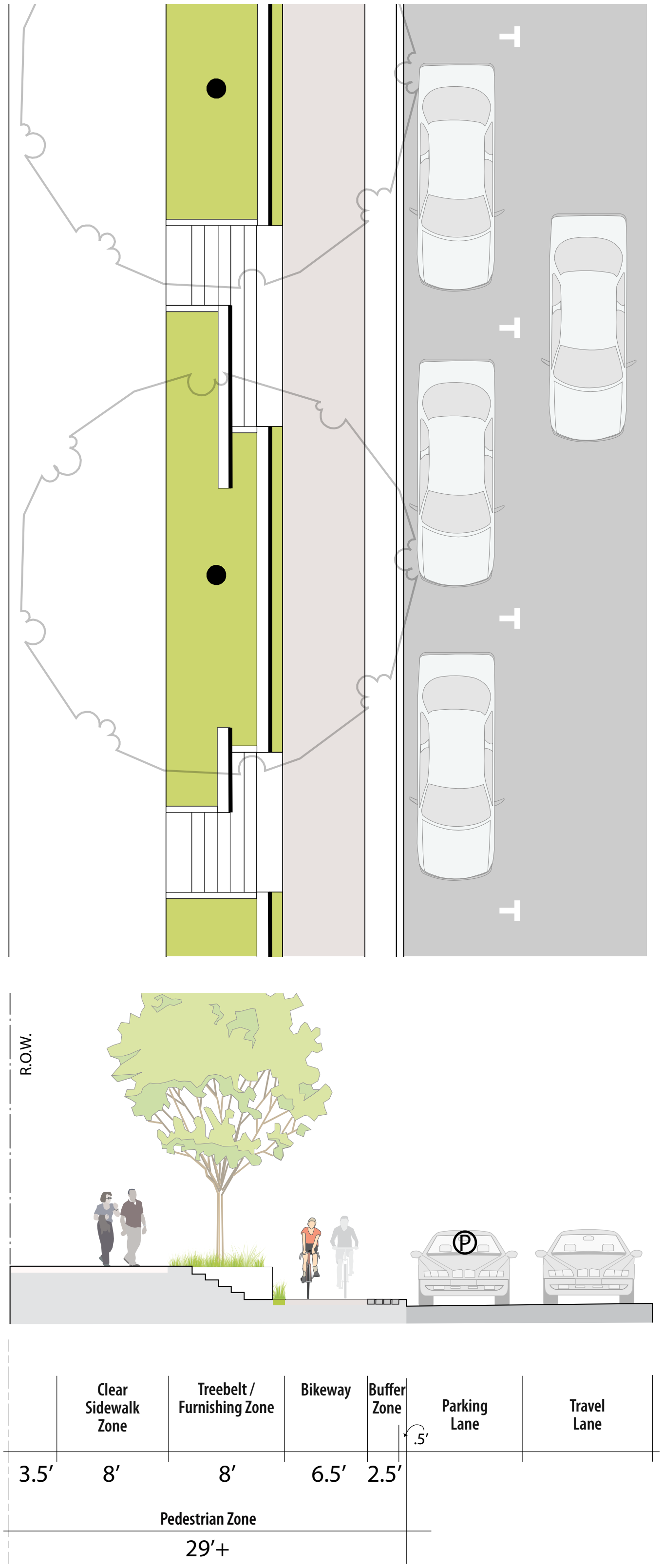
Grade Changes in Pedestrian Zone

Because of Burlington's sloping terrain, there currently exist a few street conditions where there are challenging differences in elevation between street level, pedestrian walkway, and private property. These differences, for example, make it difficult for someone who parks on the street to make their way up to the sidewalk and into their destination. These discrepancies should be addressed on a case-by-case basis as conditions change from site to site, but the following diagrams address some common factors that need to be considered. In most cases, the height difference (beyond the standard 6" curb height) that needs to be mitigated between street and sidewalk ranges between 2–3 feet and the condition occurs at the mid block, not at intersections. These examples anticipate addressing the grade change within the Tree Belt/Furnishing zone.

In the first scenario (**Level Change—Wide Pedestrian Zone**, next page, left), the condition shown accounts for a raised cycle track (proposed Main Street condition) but the site conditions are generous enough to accommodate the level change while maintaining all minimum zone widths and setbacks.

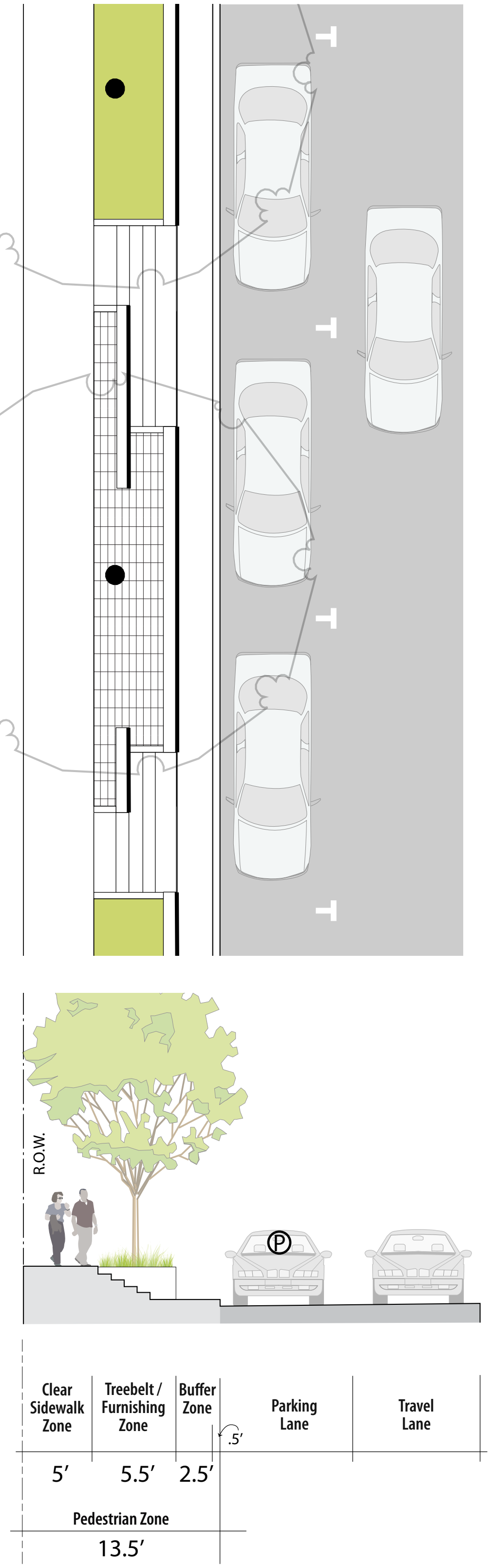
In the second scenario (**Level Change—Narrow Pedestrian Zone**, next page, right), a constrained sidewalk condition allows the level mitigation to occur within a reduced tree belt while maintaining an adequate buffer next to parking and maintaining a minimum Clear Sidewalk Zone. This condition wouldn't accommodate a Frontage Zone but paving or grates within the Tree Belt/Furnishing Zone, and should not be used for long traverses, but would allow a clear and usable sidewalk dimension with flexibility for accommodating door swings and other encroachments.

Grade Change—Wide Pedestrian Zone



Option for accommodating grade changes within a wide Pedestrian Zone, utilizing a tree belt zone that is planted or pavered.

Grade Change—Narrow Pedestrian Zone



Option for accommodating grade changes within a narrow Pedestrian Zone,with the tree belt zone utilizing either pavers or tree grates.

Intersection Zones

Intersections are critical yet challenging parts of the city streetscape and transportation network, as they are the place in which all of the various uses within the public right-of-way (ROW) come together, and intersect. Conflicts between pedestrians, bicyclists, and drivers are typically greater here, but when designed carefully, intersections can not only be safe, but they can also tap civic and economic potential by infusing these challenging spaces with street life and activity.

This document is not intended to replace the MUTCD, or preclude intersection treatments that may be appropriate for a certain location and traffic condition. These standards do provide guidance on priorities for design. In particular, intersection design should be self-evident to all users, and should promote awareness and visibility between all users so that they can more effectively share the space. In signalized intersections, delays should be minimized for all modes of travel, while prioritizing signals for pedestrians, cyclists and transit, utilizing predictable/natural signal phasing.

Pedestrian

- Intersections should be designed to be as compact as possible to reduce pedestrian exposure to traffic while crossing.
- Ensure that signal timing works for both commuters and slower walkers.
- Locate crossings and waiting areas within sight triangles.
- Reclaim area within the right-of-way that is not used for driving or cycling to sidewalk or usable pedestrian space.
- Continuity of pedestrian paths of travel and connectivity should be improved and encouraged by introducing crosswalks at signalized and unsignalized intersections where possible.
- Landscape or use sustainable materials for all spaces not used for walking, cycling or driving.

Cyclist

- Bicyclist left turns may be facilitated using intersection crossing markings, protected intersection treatments, protected lanes in advance of an intersection, bike boxes, and 2-stage turn queue boxes.
- Merge cyclists with slow speeds and low volumes, separate cyclists from fast speeds and high volumes.
- Prioritize cyclists over turning drivers.
- Ensure sufficient queue space for cyclists.
- At intersections, accommodate bicyclists through mixing zones. Avoid the use of mixing zones or restrict turns where turn volumes are likely to make bicyclists feel unsafe, or where a protected lane enters the intersection to ensure a protected facility through the intersection.
- While a dedicated bicycle signal is generally desirable from a safety point of view, an added signal phase lengthens the overall cycle length and exacerbates delay for all users.

Transit

- Minimize delay to transit vehicles using transit signal priority. Determine the transit stop placement based upon the location of major destinations, transfer activity, and route alignment. At signalized and unsignalized intersections, far-side transit stops are preferable. Bus bulbs improve transit travel times and provide a dedicated space for waiting passengers.

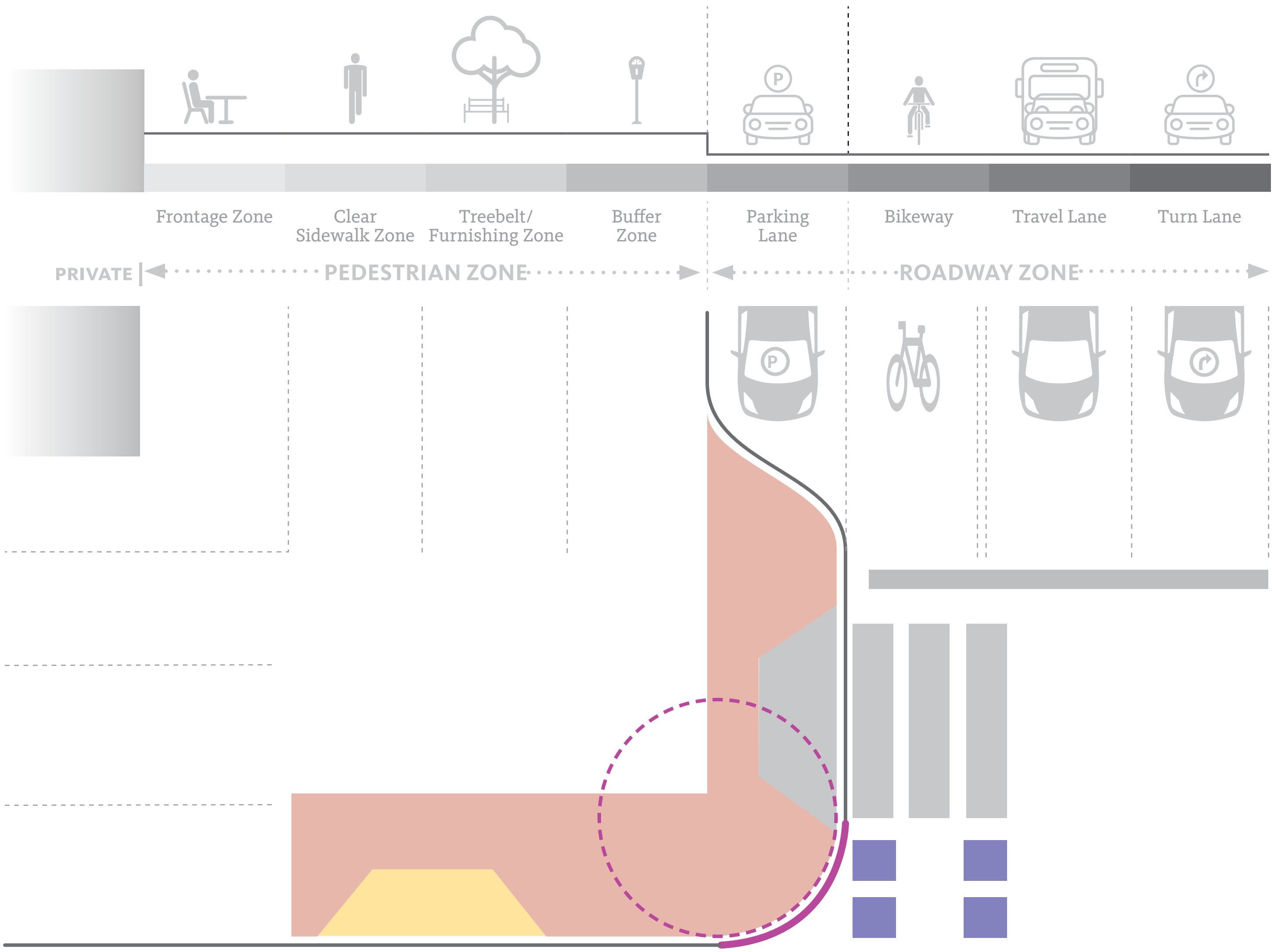
Vehicles

- Intersection design should limit the addition of dedicated turn lanes and pockets, and remove slip lanes where possible.
- Control speeds by tightly managing the design and spatial layout of intersections. Tighten lane widths and eliminate unnecessary travel lanes, reallocating space for other uses which will create a balanced use of the ROW.
- Limit opportunities for drivers to make sudden movements.
- Square off skewed intersections.
- Minimize speed, especially at turns. Curb extensions, tight corner radii, cycle tracks, and pedestrian safety islands force drivers to navigate intersections cautiously.
- Set signal timing between intersections to keep travel speeds slow.
- Align lanes so that number of approach and departure lanes are equal.
- Align lanes through an intersection and enforce turning lanes with curb extensions to reduce merging and weaving. Delineate guide markings through intersections to reduce conflicts and guide turning vehicles.

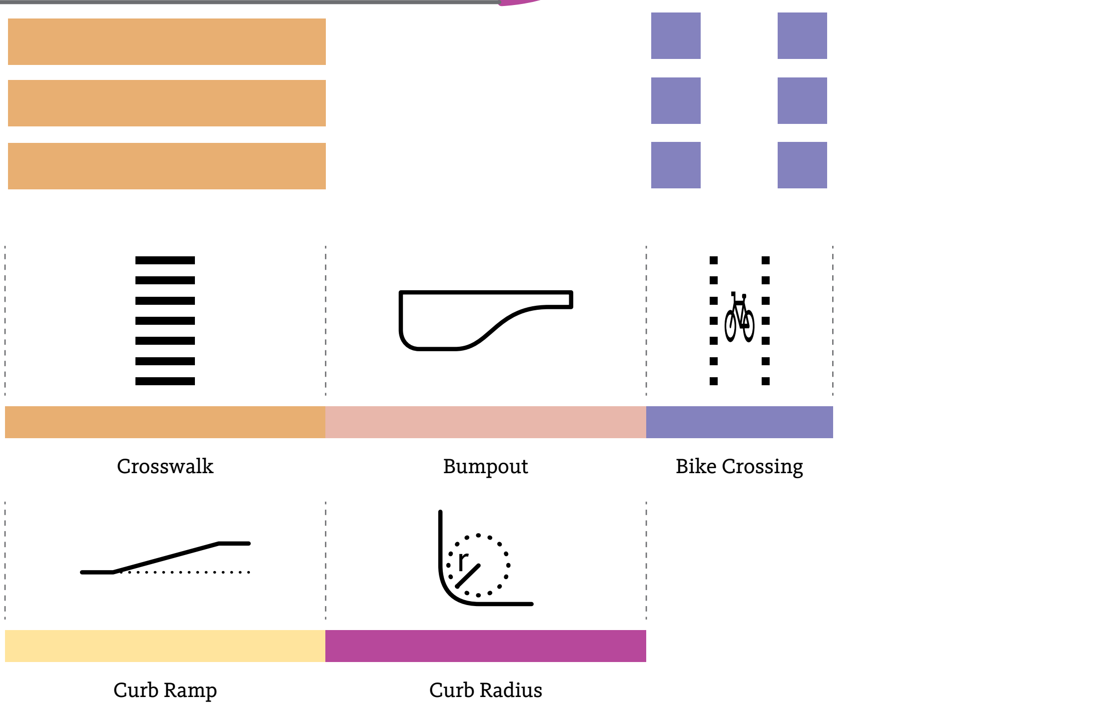
Reducing Crosswalk Length: Roadway Narrowing & Bumpouts

In addition to gaining adequate width for walkways and tree belts, reducing the Roadway Zone width allows for shorter crossings for pedestrians at intersections, which should be a priority when designing Great Streets. These standards are intended to reverse the trend towards ever longer crosswalks, as streets were widened to accommodate more vehicular traffic with more and wider travel lanes by shortening the crosswalks as much as possible, thereby reuniting the two sides of the street.

This can be combined with a second strategy of introducing "curb extensions" or "bumpouts." These are constructed at intersections, and are typically the depth of the parallel parking lane. The reductions in crossing distance and crossing time are significant, and increases the safety for pedestrians when within the Roadway Zone. On a 40' roadway, bumpouts can reduce the crossing length from 40' to 24', and the average exposure time from 10 seconds to 6 seconds. On a 35' roadway, bumpouts can cut crossing time and exposure in half, from 8 seconds to 4 seconds.



Note: These standards provide details for intersection treatments for which the City may indicate a preference; it is not inclusive of all intersection and traffic control options which may be placed within the downtown public rights of way. This document is not intended to replace the MUTCD. An intersection treatment not included in this document should not be assumed to be procluded from use within the downtown if the appropriate physical or traffic characteristics warrant its use. Professionals should consult the appropriate MUTCD standards that apply to any proposed intersection design, including but not limited those which are referenced herein.



Zone	Dimensions	Considerations	Add'l Info
Crosswalk	Commercial: 14'–16' width Residential: 10'–12' width Crosswalks may not be located within 3' of the straight line of each side of a driveway. See *"Parking Lane" on page 99* for required separation of parking from crosswalks.	Safe and frequent crosswalks support a walkable urban environment and reinforce pedestrian right-of-way at intersections. Crosswalks should be applied at: • All open legs of a signalized intersection. • Across a roadway approach controlled by a "STOP" or a "YIELD" sign if there is a sidewalk on both sides of the approach. • At intersections on roadway approaches not regulated by signals, "STOP" signs or "YIELD" signs if the speed limit is 40 MPH or less, and there are sidewalks on both sides of the approach. Because non-intersection pedestrian crossings are generally unexpected by the road user, warning signs should be installed and adequate visibility should be provided by parking prohibitions. • Mid-block as needed. Because children constitute a high percentage of the walking public, crosswalks that provide accessible routes to schools are among the first locations that should be considered. Elderly pedestrians and pedestrians with disabilities are highly dependent on transit, so providing crosswalks at or near transit stops as well as near housing for the elderly should also receive high priority. Marked crosswalks should be placed as close to perpendicular as possible, unless a traffic engineering study determines otherwise.	*page 280*
Bike Crossing	Crossing lane width should match width and positioning of the leading bike lane (5' min. width, 4' width in constrained areas)	**Protected Intersection** **Bicycle Boxes** **Two-Stage Left Turn Boxes** **Bicycle Crossing Markings** Typical Applications: • Across signalized intersections, particularly through wide or complex intersections where the bicycle path may be unclear. • Along roadways with bike lanes or cycle tracks. • Across driveways and Stop or Yield-controlled cross-streets. • Where typical vehicle movements frequently encroach into bicycle space, such as across ramp-style exits and entries where the prevailing speed of ramp traffic at the conflict point is low enough that motorist yielding behavior can be expected. • May not be applicable for crossings in which bicycles are expected to yield priority, such as when the street with the bicycle route has Stop or Yield control at an intersection. • When a bike facility intersects with a roundabout, a shared lane marking and/or ramp shall be utilized within/adjacent to the roundabout. Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority.	*page 152* *page 154* *page 155* *page 149*
Bumpout	Width: 7.5' (ensure consistent with the adjacent parking lane dimension) 5' min. length beyond extension of corner property line	With on-street parking is present, bumpouts are an ideal treatment to occupy the space between the intersection and the first parking stall for Pedestrian Zone amenities. Bumpouts can also be used for curb extension at mid-block crossings. Bumpouts should have a reflective elements at the corners on the street side for visibility in night and winter conditions. See the *"Street & Intersection Assemblies"* and *"Street Ecology: Stormwater"* sections for information on how to design and utilize the space created within bumpouts.	*page 80* *page 215*

Zone	Dimensions	Considerations	Add'l Info

Curb Ramp

Dimensions

Nominal Dimensions & Grades
- Ramp width: 48" min. flat
- Preferred width: Marked crosswalk width less 3'.
- Running slope: 1:12 (8.3%) max. in new construction
- Cross-slope: 1:48 (2%) max.
- Counter-slope: 1:20 (5%) max. at gutter
- 5' min. flat (or 2% max. slope) landing at top of ramp

Flared Ramp
- Sidewalk Ramp Type 5
- Flare slope: 1:10 (10%) max.
- Min. width: 48" (not incl. flares)

Curbed Ramp
- Sidewalk Ramp Type 3

Detectable Warning
- 24" min. from back of curb
- Full width of ramp

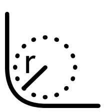
Considerations

A curb ramp provides pedestrians a smooth transition from the sidewalk to the street. Appropriately designed curb ramps are critical for providing access across intersections and at midblock for people with mobility and visibility disabilities. ADA guidelines require all pedestrian crossings to be accessible to people with disabilities by providing curb ramps. Curb ramps also benefit people pushing strollers, grocery carts, suitcases, or bicycles.
- Paired curb ramps preferred.
- One at each crossing perpendicular to curb line.
  - Within crosswalk at foot of ramp.
  - No exposure to moving traffic lane.
- Avoid diagonal curb ramps where possible.
- Avoid fully flared ramps that wrap the entire intersection curb radius.
- Small lip at connection with street for stormwater flow management.

See ref. dwg. **VTrans Standard C-3A/B Sidewalk Ramps** — *App. A-3*

"Detectable Warnings/Truncated Domes" — *page 284*

Curb Radius



Dimensions

10'–15' radius

Considerations

Curb radii determine the speed at which vehicles are able to turn corners. Within the downtown core, there is a desire to encourage slower driving speeds that improve the safety for all users. Therefore, curb radii in the range of 10'–15' will work well and support most transportation needs. Radii of as little as 5' may be acceptable if other factors increase the effective radius. In general, curb radii should be kept to the minimum consistent with overall safety and operations.

Larger radii should be considered carefully and only implemented as requirements dictate. Other treatments can be considered for high truck volume areas, such as appropriately designed truck aprons.

Roundabout

When roundabouts are used within intersections, the design should prioritize single lane, mini, and traffic circles, and:
- incorporate approach and exist angles which promote slower moving vehicles
- utilize mountable elements or a mountable roundabout itself
- include either a ramp or advisory lane markings for bicycle facilities through the roundabout

Advantages of a roundabout:
- Vehicle speed is reduced compared to other intersection types
- Pedestrians have fewer conflict points with vehicles than other intersection types
- Pedestrian judgement of safe crossing opportunity is benefitted by slower moving vehicles which are traveling in one direction
- Splitter island refuges allow pedestrians to cross vehicular flows separately
- Pedestrian crossing is accomplished in less time than a signalized intersection

Disadvantages of a roundabout:
- May require a larger footprint within the right of way than other intersection designs
- Throughput of a roundabout is greater than a signalized intersection, which might put pressure on (create stacking at) adjacent signalized intersections
- Vehicle traffic is yield controlled, so it does not come to a complete stop, which might cause some pedestrians to be hesitant to begin using crosswalk
- Roundabouts can be an unsettling design for some pedestrians depending on age, mobility, visual or other impairments, ability to judge gaps in traffic, or other factors
- Pedestrians must learn and adjust to intersection design, such as the crosswalk potentially being located behind the first stopped/slowed vehicle approaching the intersection
- For less experienced cyclists, roundabouts can be difficult to navigate

Utilities

In order to ensure an equitable balance of uses within the City's public rights of way, it is recommended that when whole blocks or multiple blocks of a street are rebuilt, the required and preferred dimensions and location of surface elements drive the relocation/replacement/upgrade of subsurface utilities whenever possible. This will provide greater continuity of and less uncertainty regarding the location of underground infrastructure, which is a problem that plagues many construction projects in the City. Additionally, this will provide more reliable access to subsurface utilities in the event that they need to be reached in an emergency, and will involve cutting and replacing less expensive and complicated portions of the street cross section. Therefore, this section indicates the City's preferred location for underground utility systems—both public and private.

STORMWATER

Stormwater drainage facilities and structures are usually located along the edge of roadway where they often present conflicts with bicyclists. Careful consideration should be given to the location and design of drainage facilities on bicycle compatible roadways. A "bicycle safe" drainage grate with acceptable hydraulic characteristics should be used in all normal applications andmust be installed flush with the final pavement or should be curb inset.

Manholes and covers should be located outside of the lane sharing area wherever possible. Utility fixtures located within the lane sharing area or any travel lane used by bicycle traffic should be eliminated or relocated. Where these fixtures cannot be avoided the pavement surface should be made flush with the particular facility.

These standards have been developed to maximize the potential use of green stormwater infrastructure, and to reduce the quantity of stormwater runoff that is utilizing the City's combined sewer system for treatment. Extensive recommendations for green stormwater infrastructure that can be incorporated throughout the Roadway and Pedestrian Zones downtown are provided in *"Stormwater" on page 215.*

AERIAL UTILITIES

These standards follow the *Municipal Development Plan* guidance that electric, telecom services that are currently aerial within the downtown core are buried when roads are reconstructed. Wherever overhead utilities exist, they should be buried when a block face or more of a street is being reconstructed.

UTILITY BOXES

Ground Mounted Controller Cabinet

Cabinet Dimensions
Vary with manufacturer, but a typical cabinet has dimensions of 26" depth and 46" width.

Concrete pad dimensions
Cabinet width + 4", depth + 4" + 2' clear zone in front of doors; 9" and 6" slab thickness.

Sub-base
2' minimum; crushed gravel—fine graded.

Setbacks
The minimum clear zone in low speed urban areas is 2' beyond the face of the curb. In other cases, the minimum is equal to the clear zone as defined by AASHTO's Roadside Design Guide. 1' min. from walkway.

Reference
See ref. dwg. **VTrans Standard E-171B Traffic Control Signals Misc. Details** in *Appendix section A-4.*

Pole Mounted Controller Box

Typical Cabinet Installation
2' pole setback from curb face (applies only in urban low speed areas). 3'–4' from concrete pad to bottom of cabinet. 1' minimum from sidewalk to pole or cabinet (when they are less than 7' above sidewalk). 5' height from concrete pad to meter socket.

Concrete pad dimensions
6" thick, 3' width, 4' depth (3.5' from face of cabinet; may be adjusted as necessary where sidewalk or roadway is adjacent to controller). Pad may be deleted when pole is placed in a paved area.

Sub-base
6" crushed gravel—fine graded.

Reference
See ref. dwg. **VTrans Standard E-171A Traffic Control Signals General Notes & Details** in *Appendix section A-4.*

Pullboxes and Junction Boxes

Wherever feasible, these should not be located within the Clear Sidewalk Zone. If located generally within the Pedestrian Zone, covers need to to be flush with the sidewalk, and feature non-slip elements.

See ref. dwg. **VTrans Standard E-173 Pullboxes and Junction Boxes** in *Appendix section A-4.*

Box Appearance/Masking

Burlington's Department of Public Works spends a great deal of time cleaning graffiti off of its property, and the gray traffic control boxes with their large, blank surfaces have been an ideal target for vandals. DPW has experimented with creative ways of addressing the issue by sponsoring the commission of a few ground mounted traffic control box murals throughout downtown. Efforts like this enhance the cultural environment, visual landscape and the quality of life for residents and visitors.

New technologies, and technologies used in other fields have made it possible to broaden box enhancement possibilities. Wraps, much like those used on city buses, have made it possible to go beyond traditional one-of-a-kind painted art and opened the graphic pool to photographers and graphic designers as well. Wraps have also made it possible to have more temporary approaches that can be replaced or changed more readily. This opens up the possibility of themed treatments that can change over time or that can be reproduced when infrastructure is replaced. Photos at right illustrate examples of treatments, including traditional painted art, and wraps with photos of historic and landscape themes.

ADDITIONAL UTILITIES REFERENCES

The following reference drawings can be found in *Appendix section A-4 "":*

- **BED Standard 1601 Underground General**
- **BED Standard 1602 Excavation and Conduit**
- **BED Standard 1603 Conduit in Trench**
- **BED Standard 1604 Typical Trench**
- **BED Standard 1605 Fiberglass Box Single Ø Transformer Specs & Installation**
- **BED Standard 1606 Single Ø Padmounted Transformer, Dead Front**
- **BED Standard 1609 Utility Hole Grounding**
- **BED Standard 1622 Three Ø Transformer Concrete Pad**
- **BED Standard 1625 Underground Enclosures**

Note: All BED standards shall meet AASHTO full H-20 load rating for utilities located in greenbelt, sidewalk, and roadway, and shall be placed in the ROW in a way that is least obtrusive.

Element Siting & Considerations

All Furnishings

Regardless of the sidewalk width, a minimum five foot (5') Clear Sidewalk Zone must be left clear from vertical streetscape elements at all times for pedestrian through passage, and should be exceeded wherever possible. Additionally, placement of elements should follow ADA guidlines outlined in PROWAG clear space requirements for streetscape furnishings. Interagency coordination is required in order to achieve these goals.

- Fixed street furnishings shall not impede pedestrian traffic in the sidewalk buffer or walkway zones.
- Provide a clear, walkable, path of 5' min. width between each building entrance and the street curb. The path must be free of fixed furnishings and be reasonably direct.
- Layout of sidewalk elements such as furnishings, signs, light poles, utility covers, hydrants, traffic control devices, and parking meters should maximize safety, comfort, and function.
- Provide adequate clear space for exiting buildings per Burlington Fire Code, including a path for egress a minimum of 10 ft long and 3 ft wide.
- 5' min. clear space between Fire Hydrants and any Streetscape Furnishings; hydrants located to minimize conflicts with motor vehicles.
- Maintain min. 1' clear space between all Streetscape Fixtures (mounted furnishings, amenities, signs, utilities, etc.)
- Maintain clear sight triangles for vehicles at intersections and driveway crossings as required by the Burlington's Comprehensive Development Ordinance.
- Signs should be consolidated (based on size) to one pole or light post to reduce clutter and maximize visibility.
- Layout of the Tree Belt/Furnishing Zone should function to store snow and consider which furnishings and elements must remain accessible during winter months.

No person may place, operate, or maintain any street furniture on a public street, sidewalk, or public right-of-way without a permit from the City of Burlington. In all cases, replacement of curbs, gutters, and sidewalks will require a permit from the City of Burlington.

A-Frame Signs (Sandwich Boards)

Temporary A-Frame signs are permitted to add variety and color to the streetscape, to promote downtown business, and to supplement business signs on facades or within the property. The following guidelines include those which are contained in the Code of Ordinances Chapter 21, Article 1, Section 5.

- A-frame signs are permitted within specified zoning districts. Within downtown, these are permitted on properties located between Battery and Winooski and Pearl and Main, as well as along Lake Street and the waterfront.
- One temporary A-frame sign is permitted per business.
- Signs may be permitted in the Frontage Zone as long as applicable clearances are met, and where the sign is located more than 12' from other previously permitted signs.
- Upon approval of DPW, signs may be placed in the Tree Belt/Furnishing Zone in an area between eighteen inches (18") and five feet (5') from the face of curb.
- Signs should not obstruct the normal flow of pedestrian traffic.
- When located in the frontage zone, signs shall be no more than 4' high × 3' wide, and the total area of the sign may not exceed 8 sq.ft.
- When located in the Tree Belt/Furnishing Zone, within 40' of an intersection, or 15' of a driveway curb cut, signs may be no more than 2.5' high × 3' wide, and the total sign area may not exceed 6 sq.ft.
- Signs may not be illuminated, animated, or electrified in any way.
- Adjacent to a street parking space (except for an accessbile parking space), the sign may be located only in the area on the sidewalk that is within five feet (5') of the beginning or end of the parking space, as indicated by the parking space markings on the street.
- Signs should be constructed of durable materials that are weather and rust resistant. Signs should be well-maintained and free of graffiti at all times.
- Signs should display the City permit number sticker on the upper right corner of the sign.
- Signs may not be attached to any other structure on the sidewalk, including trees and/or tree grates, and should be sufficiently weighted to avoid blow-down.
- Signs shall not be placed out prior to 6am, and must be removed prior to 5 PM (September 22–March 20) or 7 PM (March 21–September 21).

Banners

Banners shall be located over the Pedestrian Zone, and not obstruct in any way the public's view of traffic signals, street signs, or any other City approved sign. Banners are to be hung on City light poles with standard banner arms, or on poles outfitted with after-market banner arms installed properly by the City. The lowest banner arm should be located at least 8' AFG.

Banners on street light poles must not exceed 24" in width and 48" in height, total length including pockets. Banners must have a hemmed top and bottom and must be made of durable cloth, canvas, nylon, or vinyl. It is recommended that banners include a slit or other design feature to reduce wind loading and enhance the durability of the banner.

Benches

Benches are an important public resource and are essential in making streets friendly for pedestrians. Benches are permitted in the public right-of-way, space permitting, on all streets. Benches and other sitting elements are also strongly encouraged in building setbacks adjacent to the public right-of-way. Permits are required for private benches placed in the public right-of-way.

- Benches in a Tree Belt/Furnishing Zone that is six feet (6') or eight feet (8') wide should be oriented perpendicular to the street. In narrower Tree Belt/Furnishing Zones, benches may be oriented parallel to the street, facing the sidewalk. In all cases, benches should be a minimum of 18" from the face of the curb.
- Benches in the Frontage Zone are encouraged, space permitting, adjacent to blank walls or if approved by tenant. Minimum Clear Sidewalk Zone of five feet (5') should be maintained.
- Backless Benches: Provide 36" clear space in front of and behind benches for pedestrian accessibility.
- Benches with backs: Provide 36" clear space in front of benches for pedestrian accessibility.
- Multiple street furniture elements such as planters and benches may be combined in one installation but must meet minimum placement requirements.
- Benches should not be placed on tree grates, utility covers, or manholes. Bench placement should not interfere with ADA access ramps, accessible parking or loading areas, fire hydrants, or emergency vehicle access.
- No advertisement is allowed on benches, except placards recognizing BPRW Adopt-a-Bench donors.

Bike Corrals

Locate in street to fill one or two standard parallel parking spaces, or two to three diagonal parking spaces, in coordination with Burlington Department of Public Works. See additional detail on *page 134*.

Bike Racks

Bike racks are an important element that provide an incentive for bicycle ridership. Bike racks are strongly encouraged throughout downtown, particularly near activity areas and destinations.

- Bicycle racks are encouraged in the Tavree Belt/Furnishing Zone and in bumpouts.
- Bicycle racks are allowed in the Frontage Zone and within a building setback as long as they do not impede pedestrian traffic in the Clear Sidewalk Zone and minimum clearances are met.
- A minimum of five feet (5') Clear Sidewalk Zone for pedestrians must be maintained including when bicycles are parked in the rack.
- Maintain 3' min. clear space between bicycle racks.
- Maintain at least three feet (3') of clearance between bicycles parked at racks and any other street furniture.
- Maintain two foot (2') minimum clear space between bicycle racks and Clear Sidewalk Zones.
- Single racks may be installed parallel to the street. Continuous (multiple or ribbon) racks may be placed perpendicular to the curb as long as minimum setbacks are met including clear pedestrian zones, 18" minimum distance from the curb face, and three feet (3') clear from other furnishings.

Bike Share Hubs

It is anticipated that many of the bike share hubs will be located on adjacent private property. When located within the public right-of-way, hubs should:

- Include bicycle parking facilities that are clearly distinguished from other public bicycle parking.
- Be located within a bike corral within the parking lane or in a bumpout.
- Adhere to other placement guidelines for bike racks and bike corrals.

Bollards

Bollards are used in areas where vehicles might encroach into pedestrian areas. They may also be used to protect street lights, street trees, public art, and other sidewalk elements from potential vehicular conflict.

- Bollards should be placed eighteen inches (18") from the curb. If there is no parking in the bollard placement area, the bollard may be installed immediately adjacent to the curb.
- All bollard installations must leave a minimum of six feet (6') of clear pedestrian passage between the bollards and any adjacent property lines.
- Bollards must be removable at locations that require emergency vehicle access.

Kiosks (Map, Information & Bulletin Board)

Three types of kiosks may be located within the downtown rights-of-way: pedestrian wayfinding information/map kiosk, event/information kiosk, and public bulletin boards.

- All kiosks should be located in the Tree Belt/Furnishing Zone, a minimum of eighteen inches (18”) from the curb face, and perpendicular to the curb.
- Kiosks may not exceed seven feet (7’) in height, three feet (3’) in width/diameter, and one foot (1') deep.
- Local event information kiosks & bulletin boards shall be separated by a distance of not less than 150’ per block face with a maximum of two kiosks per block.
- No more than two kiosks are recommended at any corner intersection.
- Where more than one local event information kiosk is located on a block, at least one must be non-curated (i.e. a bulletin board).

Movable Tables & Chairs

- Within the ROW, locate movable tables & chairs within paved Treebelt/Furnishings or Frontage Zones.
- Movable tables & chairs may not be located on tree grates.
- While no clear space is required between movable tables & chairs, it is recommended that a standard of 15 sq.ft. per person load factor be applied when determining capacity of the space the tables and chairs will occupy. This load factor is inclusive of people, tables, chairs and aisles, and is consistent with the 2013 Life Safety Code.

Newsracks

While newsracks serve an important function in the city, improperly placed newsracks can be an eyesore and a safety hazard for pedestrians. In an effort to minimize these conditions, consolidated, pedestal-mount newsracks are recommend for all installations.

- Newsracks must conform to the general placement guidelines outlined for streetscape elements.
- Newsracks should be located in the Tree Belt/Furnishing Zone a minimum of eighteen inches (18”) and no more than thirty inches (30”) from the curb face, as measured from nearest face of the newsrack.
- Newsracks may not be installed on tree grates, and must be minimum twelve inches (12") from tree grate, as measured from nearest face of the newsrack.
- Newsracks must be minimum twenty-four inches (24") from other furnishings (parking meters, benches, trash receptacles, etc.)
- Newsracks may be located in the Frontage Zone, against blank walls.
- No newsrack may be placed within three feet (3’) of a utility cabinet or on top of an underground utility vault.
- No newsrack may be placed within five feet (5’) of a fire hydrant, emergency facility, any driveway, or bicycle rack.
- Newsracks are not permitted within any accessible parking spaces, vehicle or passenger loading zones, or bus stop shelters.
- Consolidated newsrack groups may be placed in a continuous row with a maximum length of ten feet (10’). In this case, a space of no less than three feet (3’) separating each group is required.
- It is the responsibility of the newsrack operator to ensure that the newsracks are well-maintained at all times, free of graffiti and vandalism.

Parking Meters & Kiosk

When individual parking meters are used, double meter heads should be placed on a single pole serving two adjacent parking spaces.

On rebuilt streets, the preference is to use parking kiosks. One kiosk should be located for every 10–16 parking spaces, and should be centrally located between the parking spaces it is serving. At minimum, one should be located on each block served by a kiosk (if the number of spaces served is less than 10); in some circumstances, the City may consider locating the kiosks at optimal locations along the parking spaces to enhance customer service.

Pedestrian Wayfinding Signs

Pedestrian-oriented signs have been developed for downtown to assist visitors and residents. Examples of key destinations to include in signage and/or to locate signage are libraries, post offices, government offices, transit centers, schools, museums, entertainment centers, shopping districts, parks, public restrooms, and tourist attractions.

Place only enough signs to lead a pedestrian confidently to the destination by the best route. Avoid adding clutter to the streetscape; cluster signs in strategic locations on a single post where possible.

Planters

Well-maintained planters can be a colorful addition to the streetscape in areas where constraints exist that do not allow trees to be planted in the ground, or if additional planting is desired to compliment existing trees and tree pit plantings.

- Placement of planters in the public right-of-way must be approved by the city.
- Planters may be placed in the Frontage Zone, Tree Planting/ Furnishing Zone, Parklets, and bumpouts.

- Planters must be maintained at all times, free of debris, with provisions for watering and pruning. It is the responsibility of the permittee to maintain the planters and their contents.
- Movable planters may be placed on tree grates. Remove these at the request of the City Arborist.
- Planters should be placed no closer than two feet (2') from the face of curb.
- Maintain minimum one foot (1') clear space between planters and other streetscape furnishings; no clear space is required between planters.
- All plant materials with spines, thorns, or any other sharp protrusions are not permitted in the public right-of-way.
- Advertising is not permitted on planters.

Public Art

All art that is placed on the sidewalk or on a building face adjacent to the sidewalk, whether permanent or temporary, should not be a hazard to pedestrians and must meet all current codes, guidelines, and requirements, especially as it relates to the Americans with Disabilities Act (ADA). Art placement in the public right-of-way must conform to the general placement guidelines for streetscape elements. The location of artwork in the public right-of-way is to be coordinated with the City of Burlington and Burlington City Arts.

Public Restrooms

Restrooms are an essential facility for residents and visitors, and should be located in areas with high pedestrian activity, including near shopping, public parks, and highly frequented civic destinations.

- Public restrooms should be located near intersections in the Tree Belt/Furnishing Zone and sidewalk bumpout zone, a minimum of three feet (3') from the face of curb.
- Public restrooms must be placed a minimum of four feet (4') from existing sidewalk elements such as trees, benches, or street light poles.
- A minimum of five feet (5') of clear pedestrian through space must be maintained at all times.
- Public restrooms must not be placed adjacent to bus stops or fire lanes.
- Sidewalk restrooms are not recommended on sidewalks fronting an eating establishment.

Ramp Placement

Good intersection design practice suggests that all pedestrians enter a crosswalk at the same point. The placement of a curb ramp can help direct pedestrians to the preferred crossing location. Curb ramp placement is affected by curb height, crosswalk location, curb radius, and the location of other elements such as utility poles.

Paired curb ramps are preferred rather than a single diagonal ramp because they lead directly into crosswalks and have the added benefit of providing directional information to visually impaired pedestrians with regards to the location of the corner and the crossings. Pedestrians using wheelchairs must "square off " to approach a change of slope with both front wheels on the ground at the same time. A skewed approach would leave one caster on the ground, compromising balance and control.

Street Lights

- Minimum 10' from street trees.
- Maintain 36" min. clear space between street light pole base and other streetscape fixtures.
- Minimum 6' from fire hydrants and 4'–5' from driveways.

Street Trees

It is preferred to have consistent street tree spacing when possible, but the location of driveways, intersections, and the need to maintain uniform light levels within the ROW may require some variation based on the following guidelines:

- Typical street tree spacing for large and medium trees is 40' on center. (30' min.)
- Typical street tree spacing for small trees is 30' on center. (25' min.)
- Intersections: minimum 30' from intersections
- Street Lights: minimum 10' from street lights
- Curb Cuts/Driveways: minimum 6' from curb cuts/driveways
- Parking Meters: outside of tree grate area OR minimum of 4' in greenbelts
- Public Signage: distance will vary based on type of sign, direction of sign, intended viewer of sign, and viewsheds.

Traffic Control Devices

Traffic control devices (traffic and or parking signals, lights, etc) should not be placed on curb ramps, and should maximize visibility for the appropriate roadway user pursuant to the applicable standards. The application, location, type, dimension, color, performance criteria, and other specifications of traffic control devices should be determined according to the applicable MUTCD and FHWA standards. In the downtown core, the preference is street lights combined with traffic signals, in combination with pedestal-mounted traffic signals.

Transit Shelters & Stops

Good transit access, combined with ease of use and safe and comfortable transit waiting areas, makes transit more accessible for all users, thereby increasing pedestrian traffic in the downtown. Well-designed transit stops can serve multiple functions while providing services for transit users as well as for other pedestrians. Transit stops should be well-designed public spaces that allow riders to wait comfortably and out of the elements.

- Bus stops and shelters are typically located on the down stream side of an intersection, and should be placed to maintain intersection sight lines, and should not limit access to undeveloped parcels.
- GMT's adopted bus shelters should be used throughout downtown where possible. All efforts should be made to integrate transit facilities to create a unique identity for downtown.
- Shelters and other transit furniture (including trash cans, bollards, and signs) currently adopted and used by Green Mountain Transit around the Downtown Transit Center should be adopted throughout downtown wherever feasible per their transit stop classification requirements.
- Major transit stops should incorporate: shelter (with integral seating), wayfinding and information kiosk, trash cans, special safety lighting, bus stop pad per GMT standards, bicycle racks, and sign.
- Standard transit stops should include: bench, trash can, bus stop pad per GMT standards, and sign. These stops may incorporate bicycle racks as needed.
- Bus stop shelter locations must maintain clearance zones that meet ADA requirements for wheelchair accessibility to and from the shelter, and to board and exit the bus.
- Bumpouts (bulb-outs) should be considered as part of the transit stop wherever possible.
- Bus shelters must also comply with the general guidelines outlined for all street furniture.

Trash & Recycling Receptacles

It is important that litter containers be provided at frequent intervals. Their use should be convenient and they should be well-maintained at all times.

- Trash and recycling containers should be placed in the Tree Belt/Furnishing Zone, and not on tree grates. They are not permitted in the Frontage Zone.
- Trash and recycle containers should be placed a minimum of every 600 ft, on each side of the street, or as determined based on adjacent uses, except on residential streets.
- Containers should have a covered top to keep snow, water and animals out, and should not be locked. Containers must be maintained in a clean and sanitary condition at all times.
- Trash/Recycling Receptacles shall be mounted in pairs.
- Trash/Recycling Receptacles must be minimum twenty-four inches (24") from other furnishings (parking meters, benches, newsracks, etc.)
- No clear space is required between trash and recycling containers.

Tree Grates & Guards

To increase the walkable area of sidewalks as well as to protect street trees, grates are recommended for all streets with heavy pedestrian activity or constrained sidewalks.

- Standard tree grate widths are six feet (6') and eight feet (8') with special conditions requiring a five foot (5') option.
- Streets with planting strips do not require tree grates.
- Tree grates need to be inspected regularly and enlarged as necessary to accommodate tree growth.
- When tree grates are used, tree guards are required. At times, trees with guards must be inspected to ensure tree and guard are not rubbing.
- Grates should meet accessibility standards.

- Maintain 1' min. clear space between streetscape fixtures and tree well curbs/fences, or tree grates.
- Only Tree Guards may be mounted to tree grates. No other fixtures may be mounted to tree grates.

Vehicular Wayfinding Signs

The vehicular wayfinding system directs motorists into the downtown core through current gateway streets. Directional signs are placed at key decisions points within the network to direct motorists to their destinations, where parking signs would direct them to the most appropriate parking facility. Vehicular wayfinding signs must comply with the general guidelines outlined for all street furniture. Place only enough signs to lead a driver confidently to the destination by the best route. Avoid adding clutter to the streetscape; cluster signs in strategic locations on a single post where possible.

Vendor Carts

Street vendors ranging from food carts to craftspeople add life to the sidewalk and should be encouraged on commercial streets, space permitting. Church Street Marketplace maintains guidance for carts on the marketplace; for other carts within the public right-of-way, the following guidelines apply:

- Vendor carts may be located within the Tree Belt/Furnishing Zone, Bumpouts or Frontage Zones as long as they comply with the general guidelines outlined for all street furniture.
  *No vendor carts can be placed within the Clear Sidewalk Zone.
- Vendors may be located in the Tree Belt/Furnishing Zone and must leave at least six feet (6') of clear pedestrian passage between their cart and the nearest property line.
- Vendor carts cannot exceed 32 square feet (inclusive of all appendages), and 8 feet high at the highest point on the cart.
- No element of the vendor installation may interfere with access to any building including paths of travel and exiting.
- Vendor carts are not permitted on any sidewalks adjacent to an accessible parking space, a designated commercial loading zone, pedestrian loading zone, transit stop, or along a curb where parking or standing is prohibited.
- All food vendors must provide a durable trash and separate recycling can adjacent to the vending area.
- The installation must be well-maintained and kept free of litter and other debris.

Photo credit Samuel Heller—San Francisco Parklet Manual Version 2.2

Public Placemaking

Public Placemaking & Gathering

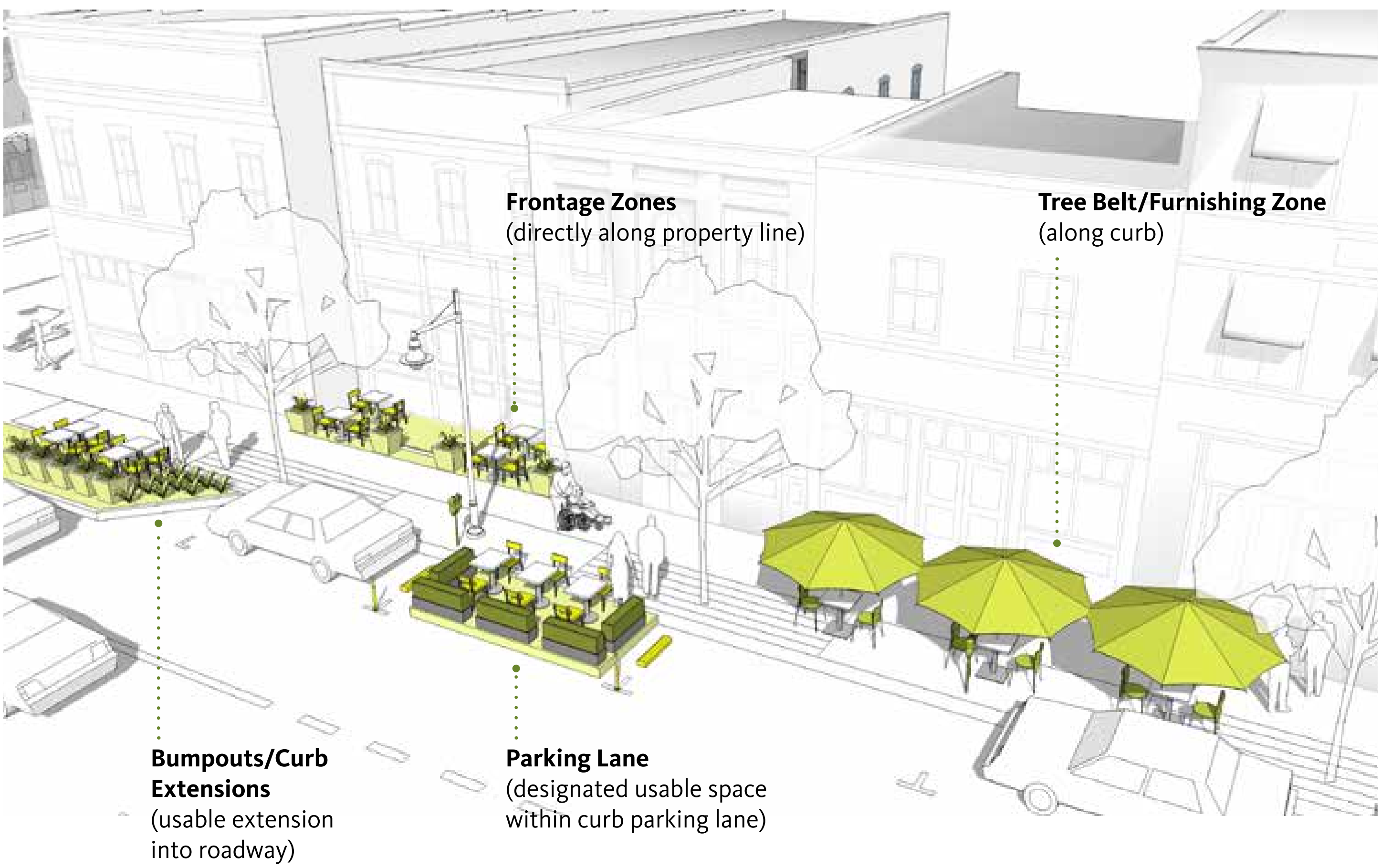
The creation of active, successful public places—public placemaking—usually occurs in or along publicly-owned spaces or rights-of-way: parks, plazas, streets, walkways. These are places which allow not only free public movement, but stopping and gathering for a variety of purposes. This may be as simple as a single person finding a place to sit and enjoy the view or observe passersby, or larger groups gathering to talk, socialize, eat, drink, and share the outdoor setting.

On a typical street, this gathering can generally occur in one of four locations:

- In the "Frontage Zone" adjacent to abutting private property and buildings.
- In the "Tree Belt/Furnishing Zone" along the sidewalk next to the roadway curb or edge.
- At an intersection on a "Bumpout" (also sometimes referred to as a"Bulb-Out" or "Curb Extension").
- In a temporary or permanent installation within the Parking Lane (also known as a "Parklet" or a "Bike Corral").

All of these public spaces can function to some extent on their own, independent of private property and private places. But along most great streets, these public places interact harmoniously with the facades and features of private buildings and spaces. In fact, *planBTV Downtown Code*, in its section on "Frontage Types," encourages active physical frontage and uses along the sidewalk; a well-designed public sidewalk helps facilitate that symbiotic relationship. Though they are driven by different rules and considerations, when public space and adjacent private activity work together, the result is usually a more vibrant public environment. These standards establish guidelines for the design of and installation within these areas, while providing enough flexibility for these placemaking opportunities to respond to the adjacent private uses which may change overtime.

PlanBTV Downtown Code includes two form districts in downtown: the "core," and the "center" (see *page 33*). While there may be properties, or even entire blocks, that are residential in nature, public gathering within the ROW is still anticipated and should be enabled, but not to the degree that is expected within commercial areas. Therefore, the public placemaking described in these Standards is intended for areas within the "core" and "center" districts which have commercial or cultural activity predominating the street level.

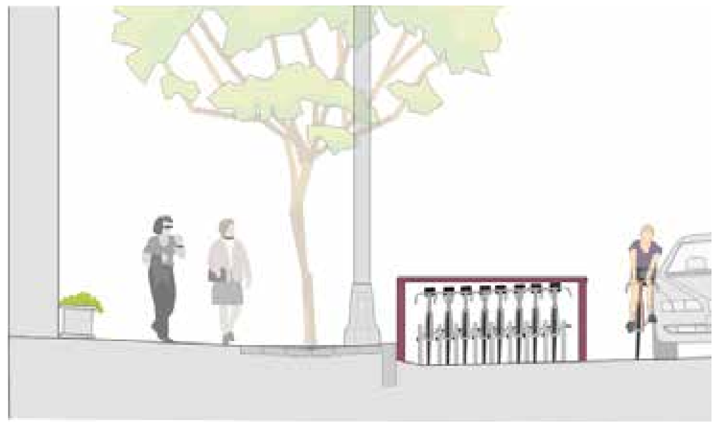


Example Placemaking Solutions

Chairs and tables in the Frontage Zone, demarcated with posts and rope

Planters in the Frontage Zone

Chairs and tables in the Tree Belt/Furnishing Zone, demarcated with posts and rope



Bike corral in the Parking Lane

Café/restaurant seatingspanning both the Tree Belt/Furnishing Zone and a parklet within the Parking Lane

Parklet with sidewalk-level platform and seating in the Parking Lane

Frontage Zones (Private & Public)

Setback Areas (Private, may allow public access)

These are spaces which blend with the sidewalk space and expand the possibilities of placemaking (see *planBTV Downtown Code* for Forecourt—14.5.15, Gallery—14.5.16, or Arcade—14.5.17). They can be paved terraces or plazas (covered or uncovered), or storefronts which open broadly onto the sidewalk and become part of its activities. Trees and other landscaping on the private property effectively become landscaped edges of public space. When used sparingly and in harmony with the public ROW, these can help make public sidewalks a "place" where the public may gather or enjoy a brief reprieve from the continuous street wall that typically defines the edges of the ROW. However, if overused, they can erode the sense of enclosure along a street, and dilute the physical and visual connections that buildings have with the active uses along them. Public officials, private stakeholders, and designers should work cooperatively to maximize mutual private and public benefit through the integration of such setbacks into the overall street design. In cases where the approved setback is adequate, the active frontage zone may sit entirely on the property rather than in the public right-of-way.

At Burlington's privately owned Courthouse Plaza on Main Street, the paved plaza created by the building setback effectively widens the public space of the sidewalk. However, streetscape elements have been placed in a way that makes the bike racks unusable.

At the Chittenden County Courthouse on Main Street, the building setback creates a public landscape that effectively widen the public space of the sidewalk.

The ground-floor facade of this café is set back onto the private property in order to create a covered outdoor space next to the sidewalk, effectively widening the public space (but not the walkable area) while enlivening the public environment and sense of place.

The facade of this florist shop is set back onto private property to create an outdoor display space that is protected by an awning; floral displays are extended across the walkway into the utility zone, effectively creating each day a temporary public landscape that pedestrians pass through, enlivening their experience on the street.

Storefronts (Private, with public interface)

The architectural facade of a building at the property line along the sidewalk forms the vertical edge of the public space, and can contribute powerfully to placemaking (see *planBTV Downtown Code* Frontage Types, especially "Shopfront"—14.5.13) . The building can create a sense of enclosure and protection, particularly when a "street wall" is established by buildings that have a consistent setback along an entire block. These buildings offer the visual and tactile pleasure of architectural materials and ornament; provide illumination at night; install signage with color, form and typography that adds interest and information to the street; present broad windows that provide views of activities within; offer sun and rain protection with overhanging awnings or other structures; and of course offer goods, food, beverages, or services to activate options for passing pedestrians. All of these help make the public right-of-way, and specifically its sidewalks, a "place" where the public may gather and enjoy. Public officials, private stakeholders, and designers should work cooperatively to maximize the mutual private and public benefit of private building facades and storefront activity within the overall street design.

A shop owner cleans windows and waters plants along Main Street—the architectural materials, wooden door, plate glass, and planter are all private contributions to the quality of place in the public right-of-way.

Brightly colored signage and umbrellas against a white two-story facade, all on private property, create a strong sense of place along the sidewalk, framed and enhanced by the foliage and shade of mature trees in the public right-of-way.

Intimately scaled and colorful bay windows with storefront displays, attractive store signs, planter boxes, and tables and chairs are all private contributions which add visual interest and vitality to the narrow public sidewalk.

On Main Street, the signs on each of the Flynn Center's three facades contribute illumination, information, color, protective cover, and spatial definition to the public sidewalk.

The deep recesses of a historic facade provide space for covered outdoor seating along the public sidewalk.

Frontage Zone (Public)

The approximately 3’–6’ of sidewalk in front of a downtown business, shop, restaurant or cafe can be of great importance both in the success of the business and in the “place” qualities of the public sidewalk and the overall public space of the street. The *planBTV Downtown Code* establishes a range of "Frontage Types," and this section is primarily related to private, commercial frontage which meets the Code's definitions of Shopfront (14.5.13), Forecourt (14.5.15), Gallery (14.5.16), or Arcade (14.5.17)

Because the Frontage Zone falls within the public ROW, it belongs to the public and should be regulated to assure public benefit. These guidelines are intended to encourage rather than inhibit the lively and imaginative use of this zone (whose width will vary depending on street conditions). Business operators have an inherent interest in creating an attractive environment along their frontage, and in some cases this includes providing the furnishings to encourage gathering: sitting, leaning, looking. The goal is to integrate the public Frontage Zone and the private Frontage for maximum public benefit and economic vitality.

Tables and chairs can be arranged in as little as 3.5’ in depth. Other elements can include planters and flower boxes, displays of goods, and signs. All of these can help make the public right-of-way, and specifically its sidewalks, a “place” where the public may gather and enjoy. Adequate space must be assured to allow for the safe and unobstructed pedestrian pathway; but some crowding should be viewed as acceptable, as occasional jostling and “rubbing shoulders” is one of the characteristics of vibrant city life. The determination of locations suitable for private utilization of the Frontage Zone should be made in consultation with the City through the Department of Public Works encumberance process.

Even on a narrow sidewalk with no trees, placemaking is possible: at this café on College Street, a single row of chairs with small round tables is shaded by an overhead trellis structure that supports planters.

At this London pub, the Frontage Zone is used exclusively for standing, which maximizes the users and resulting liveliness. Alcohol is permitted only within the Frontage area.

The Frontage Zone of this café is well related to the interior by large plate glass windows.

This dining area, which straddles the property line, combines the Frontage Zone with the building setback to widen its usable area.

Tree Belt/Furnishing Zone (Public)

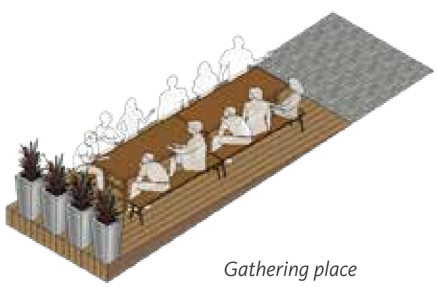
This zone, which may range in width from 6'–11' and extend nearly the full length of the city block, provides many opportunities for public placemaking. Its location and size allow for a range of uses, including:

- seat walls, benches, and built-in seating platforms
- bike parking and amenities
- chairs and tables (for public or commercial use)
- kiosks with maps and local event information, bulletin boards
- historic or cultural displays and art exhibitions
- specialty lighting
- rain gardens, tree pit planters

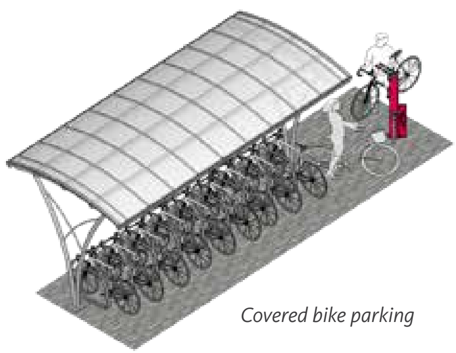
This zone, along with bumpout areas, is also critical to the maintenance and provision of a functional public realm. These spaces may be used for snow storage in the winter, and are a key portion of right-of-way that allows for the capture and treatment of stormwater before it can carry pollutants to the public waterways. The Street Ecology section will describe how these areas can be treated to achieve these goals. Ultimately, these spaces can assist with the activation of the streets, provide areas for socialization, and mee the goals for environmental performance. The determination of which uses and in what quantities should should be determined on a block by block basis, in consultation with the City through the Department of Public Works encumberance process, and with the input of adjacent stakeholders.

This paved tree belt accommodates tree wells and guards; planters with flowers; benches; bike racks, and waste receptacles.

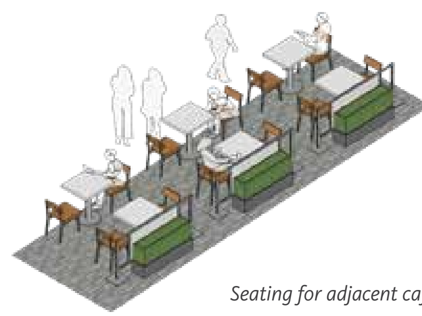
The extensive rain gardens both in the tree belt and in the adjacent bumpout frame the public walkway with greenery; a sign explains the purpose and design of the stormwater system.



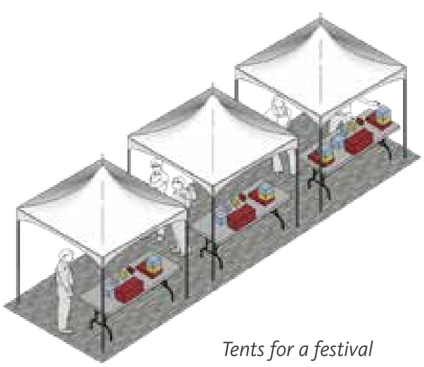
Gathering place



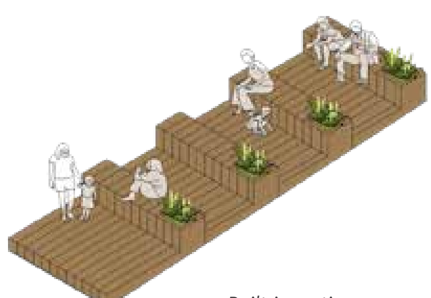
Covered bike parking



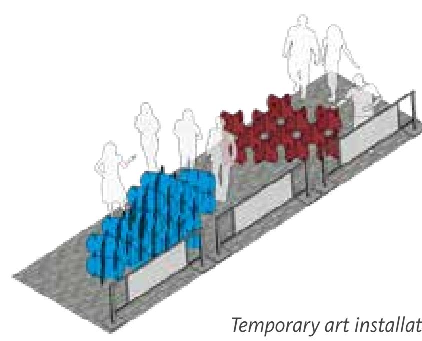
Seating for adjacent café



Tents for a festival



Built-in seating



Temporary art installation

Bumpouts

Bumpouts encourage placemaking in the same lateral zone as parklets and corrals, but at intersections instead of mid-block. Bumpouts make crossing pedestrians more visible and shorten crossing times. They also provide critical space to plant trees and capture stormwater runoff in low-lying rain gardens. They can also support public placemaking by providing space for seating and information kiosks. Because of their location, they may also provide long views down the street corridor; and their higher visibility may add to the street's overall impression of liveliness. They can be created with both permanent or temporary materials and installation techniques.

Concrete bumpout with adjacent planter barrier, wood deck, and seating

Interim bumpout created with paint and delineators, furnished with bikeshare station

Construction of a curb extension, or "bumpout"

Bumpout with pavers, tree well, bench, and trash receptacle

Parking Lane

Photo credit Samuel Heller—San Francisco Parklet Manual Version 2.2

Streets and sidewalks in downtown Burlington make up thirty-three percent (33%) of the City's land area and are an integral part of daily experience for Burlingtonians. But often sidewalks are too narrow to accommodate outdoor amenities for adjacent businesses and uses. In some cases, sidewalks can effectively be widened by extending public placemaking beyond the curb into the roadway, taking advantage of the 7.5' Parking Lane adjacent to the curb. These spaces, commonly repurposed into parklets or bike corrals, are usually captured by removing one or more on-street parking spaces and introducing other uses. Some uses can sit directly on the roadway, while others, are built on raised platforms level with the sidewalk, effectively widening the Pedestrian Zone. These areas are usually protected at each end by a parked car, and along the travel lane by a barrier.

Placemaking elements in the Parking Lane balance local needs by:

- creating a better balance the uses of city streets for all users
- encouraging walkability and cycling
- supporting lively, vibrant streets
- fostering neighborhood interaction
- supporting local businesses

The following pages provide guidelines for placemaking within the Parking Lane for:

- Parkets, which are public spaces created from a platform at sidewalk level that extends the Pedestrian Zone into the Parking Lane. They generally cover one or two parking spaces, and include an open accessible space for people to sit, rest, gather, eat and many other activities.
- Bike Corrals, which are designated areas within the Parking Lane that accommodate high capacity bicycle parking and other bicycle amenities. These could accomodate general public parking or bike share hubs.

Early "parklet" in Paris: dining in the street between two parked cars

Contemporary parklet with shade covering, located in the Parking Lane with appropriate buffers

PARKLET GUIDELINES & SETBACKS

PlanBTV Walk/Bike encourages the creation of a parklet plan for the construction of these elements throughout the City. Until such a time a resource might be available, the following pages outline the details regarding the placement and performance of parklets within the public right-of-way.

Context

Parklets should be located primiarily along active streets with retail, restaurants, civic and other mixed land uses. Generally, parklets are not located on residential streets.

Design Speed & ADT

Parklets are recommended on streets with design speeds of 20 MPH or less, and with lower traffic volumes and lower class vehicle utilization. Parklets on streets accommodating higher speeds, higher traffic volumes, and larger vehicle classes may be considered on a case-by-case basis.

Parking Spaces

Parklets are sited along the curb line on streets where on-street parking spaces exist. They can be considered in any location where there are or would be space(s) for on-street parallel or angled parking, including spaces with metered or unmetered parking.

Corner Locations

In general, parklets should be located at least one parking space away from an intersection or street corner. In some instances, an on-street bicycle corral at least 15' in length, a curb-extension (bulb-out), or some other physical barrier may allow the city to consider a parklet closer to the corner.

Other Locations

Other locations adjacent to the curb including those fronting driveways should be considered on a case-by-case basis.

Special Curb Zones

Parklets are not allowed to replace accessible parking spaces, unless the accessible parking space is relocated in close proximity. In most instances parklets are not permitted along curbs where parking or standing is prohibited.

Transit

Parklets are not permitted in a bus stop, but may be located adjacent to a bus stop.

Utilities

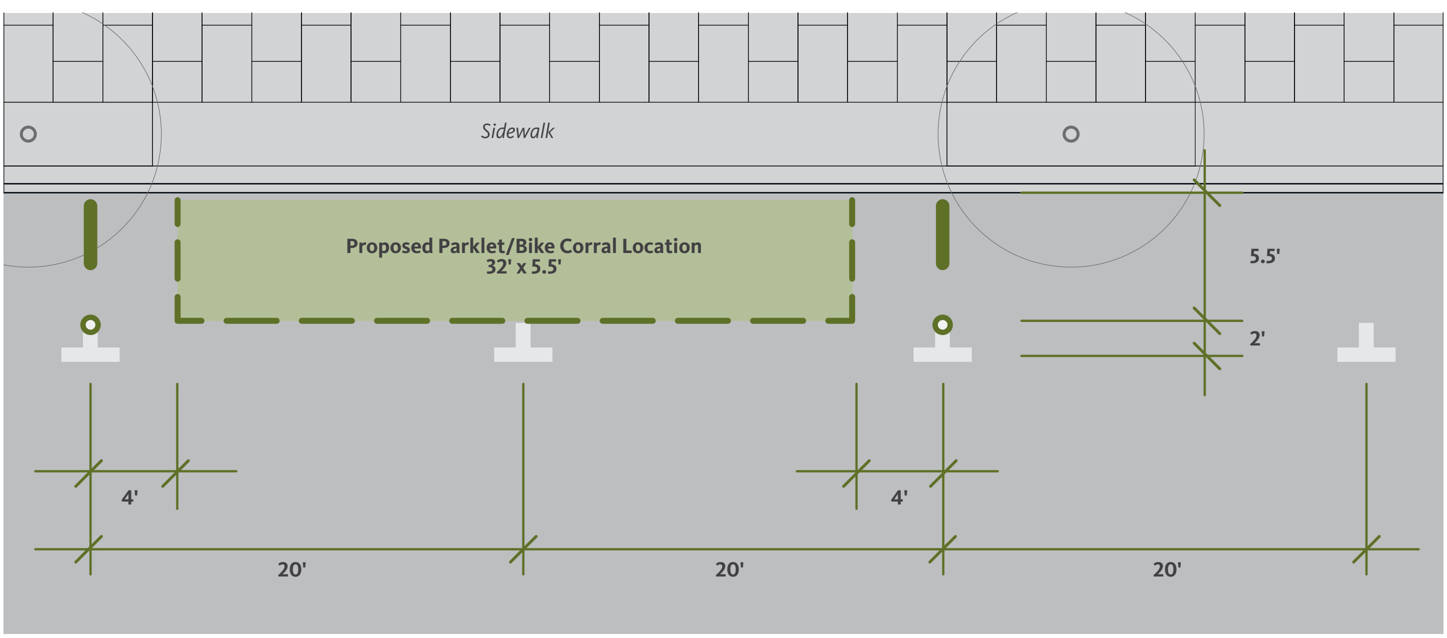
Parklets may not be constructed over utility access panels, manhole covers, storm drains, or fire hydrant shut-off valves.

Designed for Easy Removal and Restoration

Parklets should be designed for easy removal in case of emergency, for access to underground public utilities, and during the winter for snow removal and storage. For long-term installations, parklet locations and duration of installation should be reviewed for potential conflicts with future programmed streetscape improvements.

Parklets Are Public

Parklets are public spaces and should feel open and welcoming to passersby. Parklets are encouraged to display signs which state that all seating is publicly accessible at all times. When developing the parklet plan, the City will consider whether a policy on the private use of parklets by sponsors is appropriate.



Parklet dimensions and setbacks

No Advertising
Logos, advertising, or other branding should be prohibited. A small unobtrusive plaque recognizing project sponsors and material donors may be acceptable.

Siting Requirements

All parklet structures must be setback on three sides, creating clear areas as a buffer from adjacent on-street parking spaces, driveways, and travel lanes.

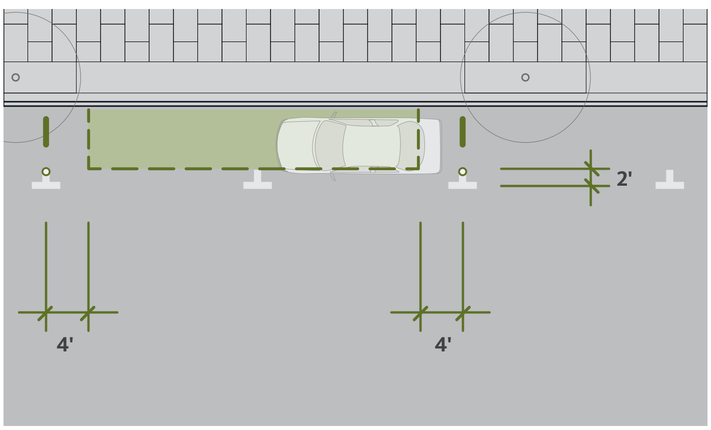
Parallel Parking
When replacing parallel on-street parking, most parklets should be the size and length of one or two parking spaces. Larger parklets could be considered depending on circumstance and existing site conditions. Smaller parklets have also been successful. For parallel parking, the parklet structure must be set back 48" from adjacent parking spaces, and 24" from travel lanes (18" minimum).

Diagonal Parking
Where parklets are installed in diagonal parking spaces, it is recommended that they be designed to be the size of three combined parking spaces to maximize habitable space within the parklet. For diagonal spaces, the edge of the parklet must be set back 36" from the adjacent parking space on either side, and 24" from travel lanes (18" minimum).

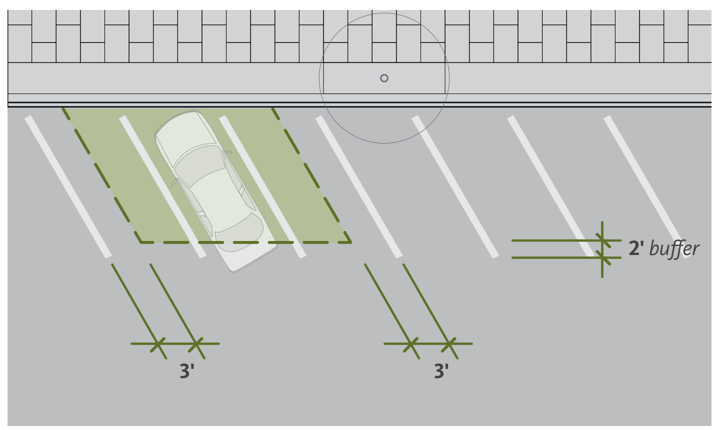
Nearby Driveways
Parklets located next to driveways must be set back 3' from the outside edge of the driveway.

Areas Without Marked Parking Spaces
In areas where parking spaces are not marked on the pavement, the proposed parklet should not leave an "orphaned" space that is too small to use as a full parking space.

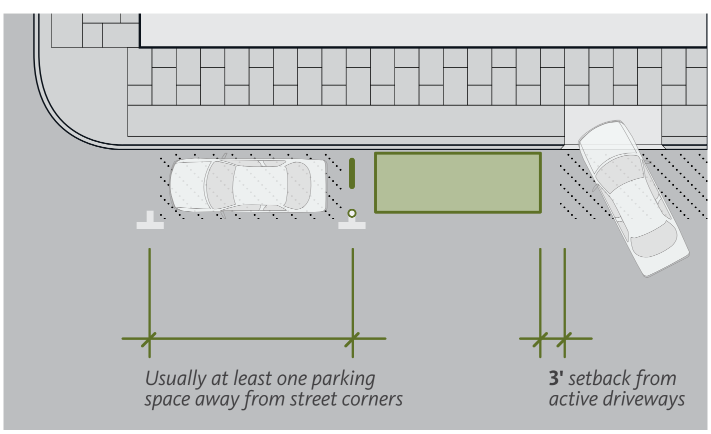
Street Slope
Parklets are generally recommended on streets with a running slope (grade) of 5% or less. Parklets may be permitted on streets with a running slope (grade) over 5% if the parklet is designed to provide safe access for wheelchair users.



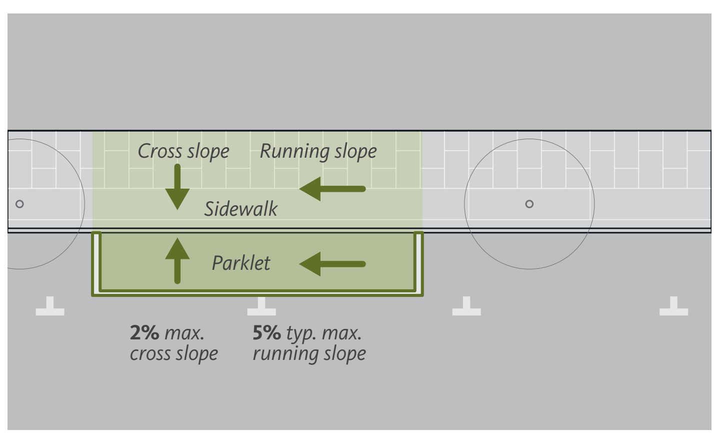
Parallel parking



Diagonal parking



Corner locations and driveways



Street Slope

Platform

Threshold
Any openings between the sidewalk and the Deck Surface shall be flush without a horizontal or vertical separation greater than ½". Changes in level ¼" to ½" high maximum shall be beveled with a slope not steeper than 1:4 (25%).

Bolting
Bolting into the street or penetrating the surface of the road in any way is strongly discouraged. Parklets may be bolted to the existing curb, but only with a restoration plan.

Platform Surface
The top of the parklet platform must be flush with the sidewalk with a maximum gap of ½". In the case of a sloping street, see accessible guidelines in the following section.

Surface Materials
Parklet materials are highly recommended to be slip-resistant. Loose particles, such as sand or loose stone, are not permitted on the parklet.

Substructure
Parklet platform load-bearing weight standards vary by agency. At a minimum, design for 50 lbs/sq. ft.

Access
If the platform base is not a solid mass, the clear space underneath the platform surface must be accessible for maintenance through access panels, removable pavers, etc.

Drainage
The parklet cannot impede the flow of curbside drainage. Designers are strongly encouraged to cover openings at either end of the parklet with screens to prevent debris buildup beneath the deck and in the gutter.

Enclosure

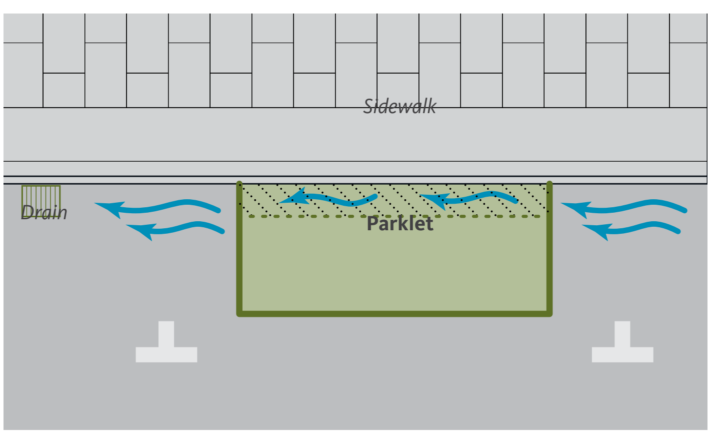
Buffer/Edges
The parklet should have an edge as a buffer from the street. This can take the form of planters, railing, cabling, or some other appropriate enclosure that is at least 6" in depth. The height and scale of the buffer required will vary depending on context. If cable railing is used, Building Code requirements must be followed, which indicates spacing between cables cannot exceed the diameter of a tennis ball.

Visual Connection to the Street
Designs should allow pedestrians on either side of the street to see into the parklet. Continuous opaque walls above forty-two inches that block views into the parklet from the surrounding streetscape are highly discouraged.

Overhead Elements
Overhead elements that span the sidewalk and connect the parklet to the adjacent building facade are not permitted.

Extend the Sidewalk
Parklets should be designed as an extension of the sidewalk, with multiple points of entry along the curbside edge.

Parklet Walls
While not visible from the sidewalk, the outside of the parklet enclosure is highly visible from across the street. Large blank walls can be an invitation for tagging. This can be mitigated by adding visual interest like pattern, color, modulation or planting.



Drainage


Installation of parklet platform in the Parking Lane


Finished parklet in Parking Lane, with planter enclosure

Elements

Integrated Elements

Parklets should include some permanent seating integrated into the parklet structure. This ensures that the parklet still feels welcome after movable furniture like tables and seating are taken inside at night.

Movable Elements

The Material and Furnishings Palette identifies options for movable tables and chairs on *page 292* that can be utilized in public parklets. Other options can be utilized to contribute to the theme or arrangement of the parklet.

Planting

Integrated planting is strongly encouraged. Native plants, plants that provide habitat, and drought tolerant plants are encouraged.

Lighting

Lighting elements are strongly encouraged, but electrical connections to buildings will require separate electrical approvals. Designs should strongly consider solar-powered lighting over the option of running electricity from an adjacent building.

Bicycle Parking

Integrated bicycle parking is strongly encouraged. The Materials and Furnishings Palette identifies options for temporary and high capacity bicycle parking on *page 296* which are preferred for bike corrals, although custom racks may be installed as well. Bicycle parking can be incorporated into the parklet proposal in the following ways:

- Custom bicycle racks integral to the parklet structure.
- On the parklet platform. Applicants may wish to install bicycle racks on top of the parklet platform.
- On-street bicycle corral (adjacent to the parklet).

Art

Parklets are encouraged to include a diversity of art including conventional elements, interactive pieces, performance and others.

Parklet with built-in benches

Parklet with movable chairs and tables

Bike corral in Parking Lane, sized to a single parking space

Mobile parklet

Accessibility

Accessible Path of Travel

An accessible route must connect the sidewalk to the:

- Parklet Entry
- Deck Surface
- Wheelchair Turning Space
- Wheelchair Resting Space

The Accessible Path must be a minimum of 48 inches wide on the sidewalk and not pass over tree wells. Once on the parklet's Deck Surface, the Parklet Path must be a minimum of 36 inches wide.

Accessible Entry

The Accessible Entry is where the Accessible Path crosses the threshold from the sidewalk to the Deck Surface. An ideal Parklet Entry should be located in an unobstructed area where there is the least amount of running slope along the sidewalk and curb.

Accessible Deck Surface

The portion of the parklet deck connected by the Accessible Path of Travel to the Wheelchair Turning Space and Wheelchair Resting Space must be level. The Accessible Deck Surface maximum cross slope (perpendicular to the sidewalk or curb) cannot exceed 1:48 (2%). The Accessible Deck Surface maximum running slope (parallel to the curb) cannot exceed 1:48 (2%)

For other Deck Surfaces, the running slope may not exceed 1:20 (5%). The Deck Surface shall all be on one level unless the change in level is served by a ramp, additional Parklet Entries, or otherwise permitted on a case by case basis.

When stairs or ramps are permitted, they must meet all building code requirements for rise, run, width, handrails, and contrasting stair striping for the visually impaired.

Wheelchair Turning Space

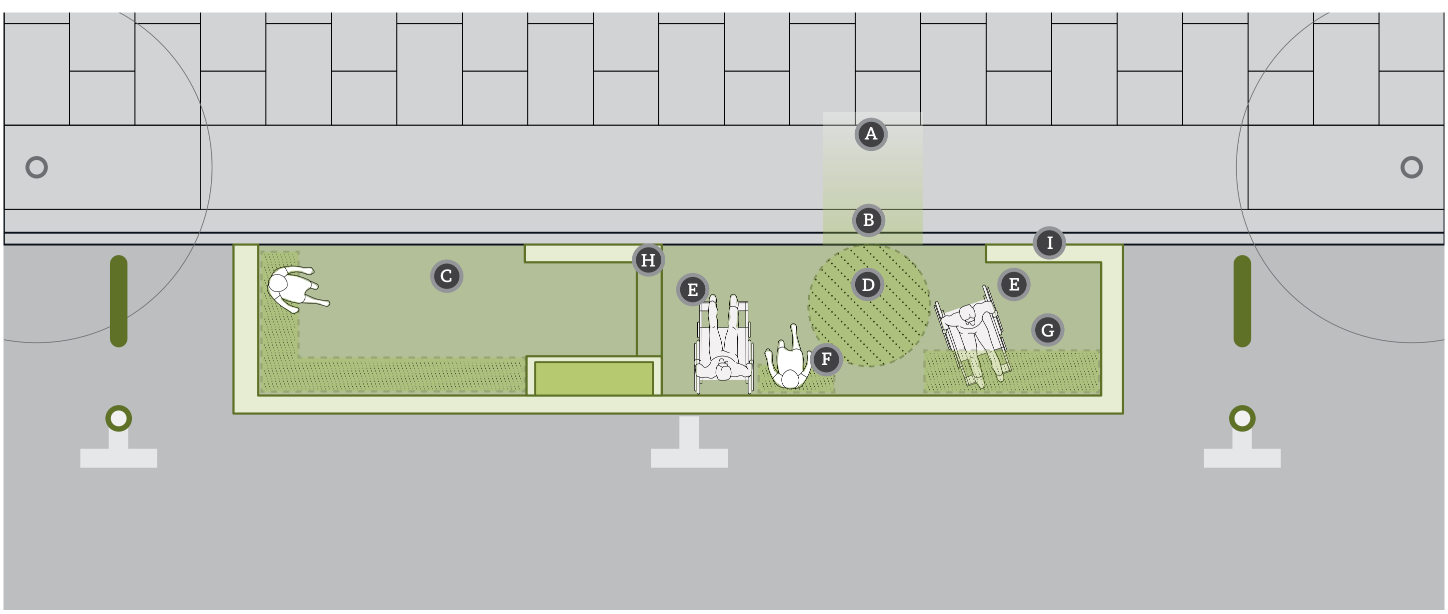
A Wheelchair Turning Space is a circular area 60" minimum in diameter for use by a person with mobility aid to make a 360-degree turn. This space shall be located entirely within the Parklet, unless otherwise approved. The maximum encroachment shall be 12" over the curb and sidewalk unless otherwise permitted on a case by case basis. Within this space there shall be no cross slope in any direction that is greater than 1:48 (2%). Alternatively a "T" shaped Turning Space is permitted.

Wheelchair Resting Space

Wheelchair Resting Space has a 30" × 48" clear floor area. The Wheelchair Resting Space is permitted to overlap the Wheelchair Turning Space by 24" maximum in any orientation.

Wheelchair User Companion Seating

If fixed seating is part of parklet design, it should be configured to accommodate companion seating for a wheelchair user. The Wheelchair Resting Space should permit shoulder-to-shoulder alignment adjacent to one side of the fixed seat.



- A Accessible path of travel
- B Accessible entry
- C Accessible deck surface
- D Wheelchair turning space
- E Wheelchair resting space
- F Wheelchair companion seating
- G Equivalent facilities
- H Step between terraces
- I Buffered edge where curb drops away

Equivalent Facilities
Where tables, counters, or drink rails are provided, at least one of each feature should be wheelchair accessible.

The top surface height of wheelchair accessible tables, counters and or drink rails should be 28"–34" above the Deck Surface. Wheelchair accessible tables, counters, and drink rails shall be approachable from the front and provide an unobstructed knee clearance that is at least 27" high, 30" wide and 19" deep. When movable tables are provided in lieu of fixed, at least one of the movable tables must also be accessible.

Where drink rails are provided, a 60" long portion of a drink rail shall have 36" wide and level space adjacent to it for a side-approach by a wheelchair user.

Terraced or Multi-Level Parklets
For parklets proposed on streets with grades that exceed 5%, a terraced parklet with two or more habitable decks is acceptable. At least one of these terraces must be wheelchair accessible and provide equivalent seating, tables, and countertop facilities to those found in other habitable terraces.

Wheelchair Accessible Entry
The accessible terrace will require a wheelchair accessible entry from the sidewalk. The wheelchair accessible entry may be achieved with a structure on the sidewalk within the sidewalk furnishing zone that provides transition between the sidewalk and parklet deck.

Ramps, Steps & Stairs
Communication between terrace levels may be achieved with a ramp with a running slope not to exceed (1:20) 5%; steps or stairs. Any step or stair will require a warning strip at the nose of the step and handrails per building code.

PARKLET MATERIALS

Parklets are intended to be aesthetic improvements to the streetscape. They should be designed with this in mind, ensuring that the materials that are used are high quality, durable, and beautiful.

Locally Sourced Materials
Sourcing locally produced materials for parklets supports the local economy and reduces the embedded carbon footprint of the final structure by reducing transportation costs.

Recycled and Reclaimed Materials
Choosing recycled and reclaimed materials for parklets is highly recommended and has the additional benefit of reducing construction costs and keeping materials out of landfills.

Low Emission Materials
Choosing paints, stains, glues, and other materials that emit zero or low levels of volatile organic compounds (VOCs) helps improve air quality as well as the health of the people who are constructing and using parklets.

Avoid Plastic
Plastic of any kind, including Plexiglas, is strongly discouraged.

Materials that Are Easy to Maintain
Having a strategy for removing graffiti, and replacing or repairing damaged parklet features such as plants, railings, or other elements is highly encouraged. Whereas some materials may cost more initially, they may ultimately save money in maintenance costs. For example, aluminum costs roughly three times as much as steel but when tagged, it can simply be cleaned with acetone. Project sponsors are ultimately responsible for making sure that their parklet is kept clean and in good repair.

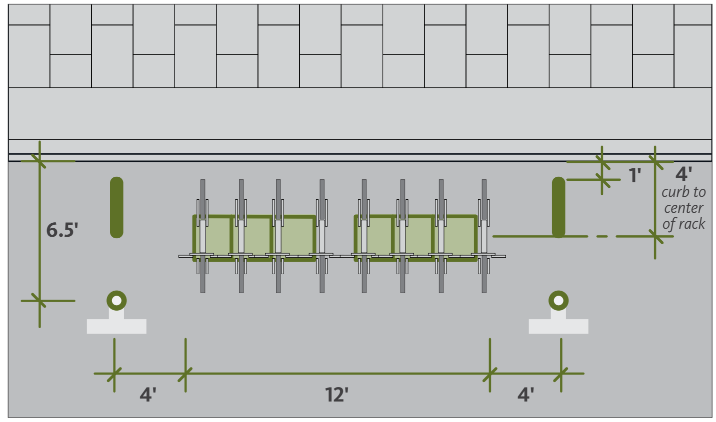
Sustainable Timber Products
Parklet designs may not use tropical hardwood or virgin redwood. This includes FSC certified wood products.

No Pressure Treated Wood or Plywood
Pressure treated lumber or plywood wood are not allowed in places where they will be visible.

BIKE CORRALS

A bike corral is a designated area for short-term bicycle parking. Bike corrals provide parking for a number of bicycles in a compact area. Bike corrals may be located on sidewalks, in parking lots, or other areas behind the curb, but are often placed in the curb lane of the street. By converting a parking space into space for a bike corral, cities can accommodate parking for 12 to 20 patrons on bicycles in the space typically used to park one automobile. Bike corrals can replace bicycle hoops, bike racks, freeing up sidewalk space for other uses such as additional pedestrian space or café dining. Bike corrals are an excellent solution for accommodating a large number of bicycles near specific activity areas and in areas with narrow sidewalks. Bike corrals are often highly valued by ground floor businesses. Despite removing a valuable curbside parking space, many businesses have found that bike corrals improve accessibility and visibility to their establishment(s) in addition to relieving pressure on limited sidewalk space.

- Bicycle parking is potentially needed in any frontage type, but is particularly necessary in Commercial, Civic/University, or Mixed use areas.
- In Destination Commercial areas, there may be competing needs for use of the Tree Belt/Furnishing Zone (e.g. for café dining & outdoor retail) and bicycle parking should be located to keep those areas open. Consider placing bicycle parking closer to intersections and not immediately in front of potential occupancy areas.
- Bicycle parking should be plentiful, dispersed, visible and conveniently located.
- Bicycle parking should facilitate transfers between modes. It should be accessible to major transit stops, transfer points and the Downtown Transit Center.
- Locating bicycle parking near to corners improves visibility, access to curb ramps, and accessibility to more block frontages. Parking should be located far enough away from the corner to avoid conflicts with curb ramps or sight lines.



Placement of corral elements in standard 20' Burlington parallel parking space.

REQUIRED BUFFER ELEMENTS

The following elements are required for parklets and bike corrals within the downtown on "slow streets." Additional protection/buffers may be required on a case-by-case basis for streets with higher volumes of traffic, higher speeds, or streets which accommodate larger vehicle classes as required by the City Engineer.

Safe-Hit Posts

Two (2) standardized safe-hit posts will be required, one for each end of the parklet. Posts must meet these specifications:

- Safe Hit Type 2 Guide Post
- 36" tall, white
- Surface Mount Pin Lock Base.
- Butyl Adhesive Pad or anchored
- Parallel parking: installed 7' from curb edge in line with wheel stop and parking bay markings
- Angled parking: install 15' from curb edge in line with parking bay markings

Wheel Stops

Two (2) wheel stops will be required, one for each end of the parklet. Wheel stops must meet these specifications:

- 3' long
- 6" reveal, concrete (preferred) or black rubber with yellow stripes
- Mounted with bolts
- Parallel parking: installed 4' from outside ends of Parklet and installed 12" from the curb (long end perpendicular to curb)
- Angled parking: installed 15' from the curb (long end parallel to the curb) and 12" towards the center of the parklet from the Soft-Hit Posts

Public Parklet Signs

Parklets must display two (2) “Public Parklet” signs, one at each end. Final placement of the signs will be reviewed to ensure optimum visibility. Not required on bike corrals. City to provide graphic file. Signs must meet the following specifications:

- 5" tall by 11" wide
- Copy must include “Public Parklet” and “All Seating is Open to the Public”
- 0.125” (⅛") anodized aluminum wrapped with laminated digital print. Applied white copy—reflective.

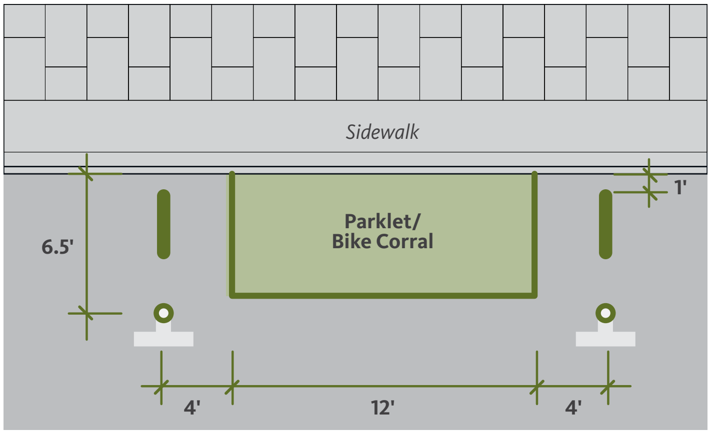
UPKEEP & MAINTENANCE

Parklets and bike corrals should be well-maintained and in good repair at all times. The City is encouraged to work with adjacent property owners, or to obtain parklet sponsors, which keeping the parklet free of debris, grime, and graffiti, litter, and to keep all plants in good health.

3 ft. concrete wheel stop

Safe-hit posts

Public Parklet sign



Placement of elements in standard 20' Burlington parallel parking space.

Right-of-Way Encumbrances & Permits

Permits are required by the City of Burlington for any person, firm, or corporation to block or disturb the ground or pavement of any street, sidewalk, green belt, or curb within the right-of-way. The incorporation of dimensional, material, and siting standards for elements that may be placed in the right-of-way, for short or long term purposes, does not waive the requirement to obtain a permit to occupy the right-of-way. Businesses and property owners that wish to pursue opportunities for placemaking (i.e. locating elements within the public right-of-way) shall submit a permit application to be considered by the City.

Relative to the Great Streets Standards, encumbrance permits cover movable tables and chairs and permanent encumbrances (such as an accessible ramp) within the right-of-way. Requests for encumbrances should adhere to the *"Element Siting & Considerations"* outlined in this chapter. Particularly, new requests for permanent encumbrances or for occupation of the right-of-way for a defined period of time, may not encroach into the minimjum 5' Clear Sidewalk Zone nor inhibit the required path for egress from adjacent buildings. A separate permit is required for A Frame Signs (Sandwich Boards). Permit applications shall adhere to the requirements articulated in the City Code of Ordinances, which are summarized in the *"Element Siting & Considerations"* section of this chapter.

Existing Encroachments

Throughout downtown, there are existing encroachments into the public right-of-way-- many of which are known, but others which are yet to be discovered. Existing encroachments fall into two categories: permitted and unpermitted. Encroachments should be handled on a case-by-case basis by the City Engineer, but the following guidance should be consulted.

In the case of permitted encroachments, project designers should work with the City and the property owner(s) to deterimine if a design solution is achievable to remediate the encroachment. For example, if an entire block face is redeveloped, designers should explore whether the opportunity exists to adjust the grade of the sidewalk to meet ADA access requirements into adjacent buildings, thus eliminating ramps which encroach into the public right-of-way. If remediation is not feasible, project designers should accomodate the encroachment in the plan for the street.

In the case of unpermitted encroachments, project designers should work with the City and the property owner(s) to determine if a design solution is achievable to remediate the encroachment. If remediation is not feasible, and the encroachment provides the primary entrance/egress or required ADA accessibility to an adjacent structure, project designers should accomodate the encroachment in the plan for the street, and property/business owners shall be required to receive an encumberance permit from the City per any effective City Policy regarding existing encroachments. If remediation is not feasible and the encroachment is non-essential to the safe operation of an adjacent structure (i.e. a landscape area, sign, parking area, etc) property/business owners shall be given the opportunity to remove the encroachment prior to the public project/reconstruction of the street at their own expense. In the case that it is not removed by the property/business owner, the project shall remove it and will not provide compensation to the property/business owner for the loss of the encroachment.

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4 Bikeways

Because of the great difference in skill levels among bicycle riders, the varied topography of downtown Burlington, and because the needs may differ based on the utility of each trip, different types of bicycle facilities are needed to serve riders. Some bicyclists are best served by bicycle-compatible streets designed to accommodate shared use by bicycles and motor vehicles, topography and other constraints permitting. The majority of bicycle riders will be especially interested in riding on bikeways which are designated facilities that are comfortable and convenient.

Bikeway Types

General Bikeway Considerations

The following is a set of considerations that should be applied to all bikeway types when appropriate:

- Wider bicycle lanes are appropriate where high volumes of bicycle riders are expected.
- For bicycle lane widths on streets with grades greater than 4%, bicycle lanes should be designed with a higher design speed. Design speed will vary, but typically will range from 10–15 MPH. The following are options to adjust the design for the higher design speed.
  - Select values for horizontal curvature, stopping sight distance, and other geometric features for a higher design speed.
  - Widen lanes by one ft for grades between 4% and 6%, and 2 ft for grades over 6%.
  - Increase horizontal clearance and recovery area.
  - Use mountable curb rather than vertical or beveled curb along bike lane
  - Provide signage alerting bike riders to steep grades.

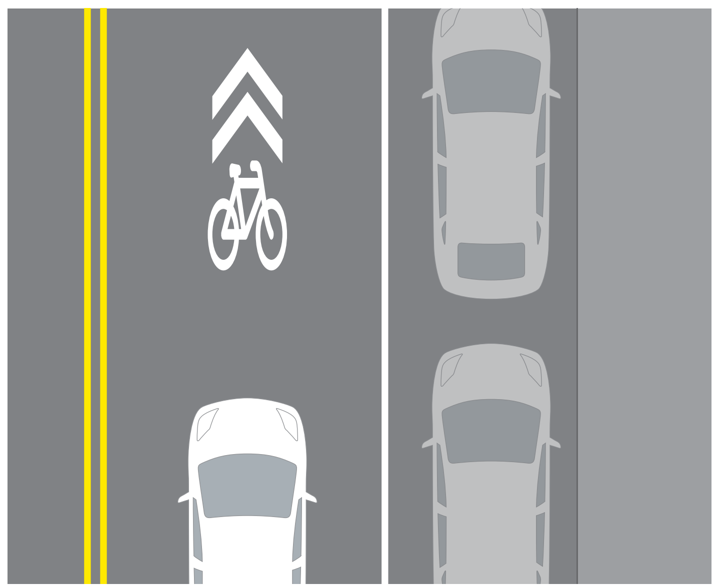
Shared Lane

Shared lanes (sharrows) are particularly appropriate in two circumstances: a) on low-speed, low-volume neighborhood streets that are designated as primary bicycle corridors; and b) in the downhill lane of a street that has a bicycle lane in the climbing direction, and where vehicle speeds are low enough that a typical downhill bicyclist will be traveling at the same speed as cars.

Shared lane markings should not be considered a substitute for bicycle lanes, protected facilities, or other separation treatments where these types of facilities are otherwise warranted or space permits. Shared lane markings can be used as a standard element in the development of bicycle boulevards to identify streets as bikeways and to provide wayfinding along the route.

Considerations

- Shared Lane Markings shall not be used on shoulders or in designated bicycle lanes.
- Should not be used on streets with speed limits higher than 35 MPH (the City of Burlington has adopted a blanket speed limit of 20 MPH for all streets not otherwise posted), or on streets where speeds and volumes are high enough that it is not desired for bicyclists to ride in traffic.
- On narrow travel lanes adjacent to on-street parking, markings should be placed outside of the door zone of parked vehicles.
- Supplement markings with "SHARE THE ROAD" signs, and "MAY USE FULL LANE" signs where appropriate.
- Can be used to complete connections between bicycle lanes and other facilities.



Per planBTV Walk/Bike, many streets within the downtown core can utilize shared lane treatments where traffic calming and design speed allow for the safe sharing of the ROW between bicycles and other modes.

Markings

- Bike-and-chevron sharrow (MUTCD Figure 9C-9)

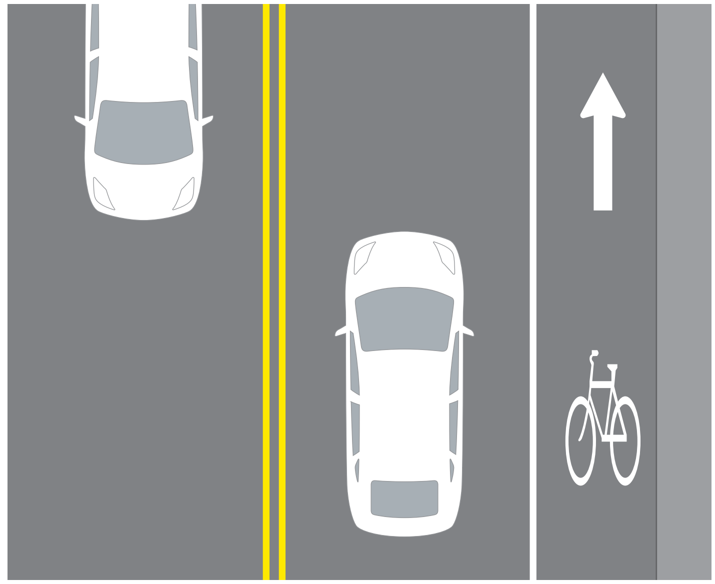
Marking Distance

- 50' after intersections
- 50'–100' apart in frequent traffic bicycle routes
- 250' + apart in low traffic bicycle routes

Lateral Location

- Center of travel lane preferred
- 11' minimum from curb when adjacent to parking
- 4' minimum from curb when adjacent to curb

Conventional Lane Adjacent to Curb



A conventional bicycle lane may be used in areas where space is not available for a buffered lane.

A conventional lane is a dedicated travelway for bicycles that is separated from vehicular travel by a painted stripe. Conventional, or unbuffered bicycle lanes, are particularly appropriate for a variety of conditions, including: a) on streets with low speeds and moderate volumes; and b) on roads with higher speeds but low volumes.

Considerations

- Wider bicycle lanes (6'–7') enable bicyclists to pass one another on heavily traveled corridors and increase separation from faster traffic.
- Uphill bike lanes should widen when slope is 4% or greater. (See *"General Bikeway Considerations" on page 141*)
- Unbuffered bicycle lanes should not exceed 7'.
- Use colored pavements to highlight areas where conflicts might occur, such as at intersection and driveway crossings.
- Where vehicles merge into the bike lane in advance of a turn movement, lane striping should be dashed from 50 to 200 feet in advance of intersections to the intersection.
- Where drain grates or other pavement conditions may encroach into the bike lane, extra width should be provided.
- Left side lanes are an option on streets with heavy delivery or transit use, high parking turnover, or other conflicts that would prevent lanes on the right side of the street.

Dimensions

- 6' width recommended on streets with a grade >4%, or with higer volumes of of bikes to allow for passing.
- 7' width max.
- 5' width min. (4' width possible in very constrained areas, but a 5' min is required next to parking)

Markings

- 6" white line adjacent to travel lane
- See ref. dwg. **VTrans Standard E-194 Bicycle Pavement Markings and Sign Layout** in *Appendix section A-5.*

Buffered Lane Adjacent to Curb

A buffered lane is separated from vehicular travel by two painted lines up to 3' apart. Buffered bicycle lanes are preferred whenever feasible when bike lanes are considered.

Considerations

- Where space is available, consider providing a buffered bicycle lane.
- Wider bicycle lanes (6'–7') enable bicyclists to pass one another on heavily traveled corridors and increase separation from faster traffic.
- Uphill bike lanes should widen when slope is 4% or greater. (See *"General Bikeway Considerations" on page 141*)
- Use colored pavements to highlight areas where conflicts might occur, such as at intersection and driveway crossings.
- Where vehicles merge into the bike lane in advance of a turn movement, lane striping should be dashed from 50 to 200 feet in advance of intersections to the intersection.
- Where drain grates or other pavement conditions may encroach in the bike lane, extra width should be provided.
- When next to parking, the buffer may be next to parking and/or next to the adjacent travel lane.
- Left side lanes are an option on streets with heavy delivery or transit use, high parking turnover, or other conflicts that would prevent lanes on the right side of the street

Dimensions

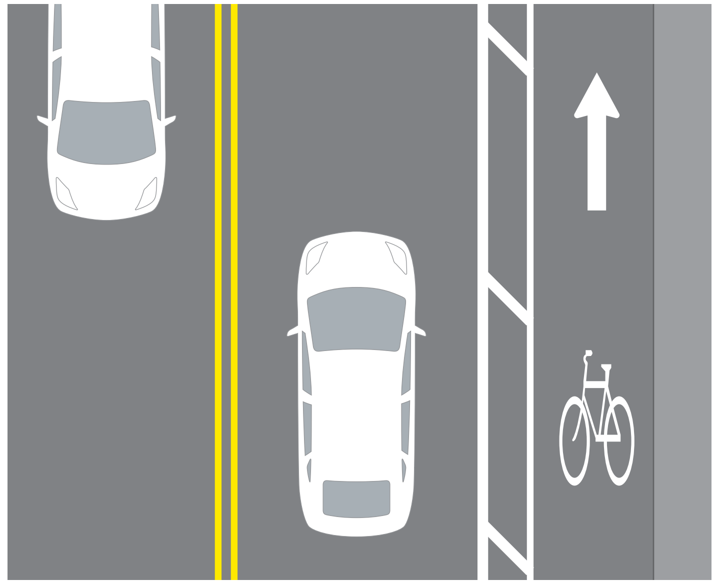
The combined width of the buffer(s) and bicycle lane should be considered "bicycle lane width." Where buffers are used, bicycle lanes can be narrower because the shy distance function is assumed by the buffer (e.g., a 3 foot buffer and 4 foot lane next to a curb can be considered a 7 foot bicycle lane). For bicycle travel next to on-street parking, a 5-foot minimum travel lane width is recommended to encourage bicyclists to ride outside of the door zone; a buffer is preferred but not required.

Buffered (preferred)

- 7.5' total width preferred (5' lane + 2.5' buffer)
- 8' total width max. (incl. buffer)

Markings

- 4" or 6" white interior line (if buffered; no interior line required when adjacent to curb)
- 6" white line adjacent to travel lane
- 4" diagonal hatching at 30–40 degrees and 10'–40' spacing if buffer is 3' or wider
- See ref. dwg. **VTrans Standard E-194 Bicycle Pavement Markings and Sign Layout** in *Appendix section A-5.*



A bufferedl bicycle lane may be used in areas where safety considerations demand more separation from traffic.

Buffered Lane Adjacent to Parking

A buffered lane adjacent to parking is separated from the parking lane by two painted lines up to 3' apart. They provide greater shy distance between motor vehicles and bicyclists. They provide space for bicyclists to pass another bicyclist without encroaching into the adjacent motor vehicle travel lane when the buffer is between the travel lane and the bike lane. They can also encourage bicycists to ride outside of the door zone when buffer is between parked cars and the bike lane. Buffered lanes are preferred when adjacent to parking lanes whenever feasible.

Considerations

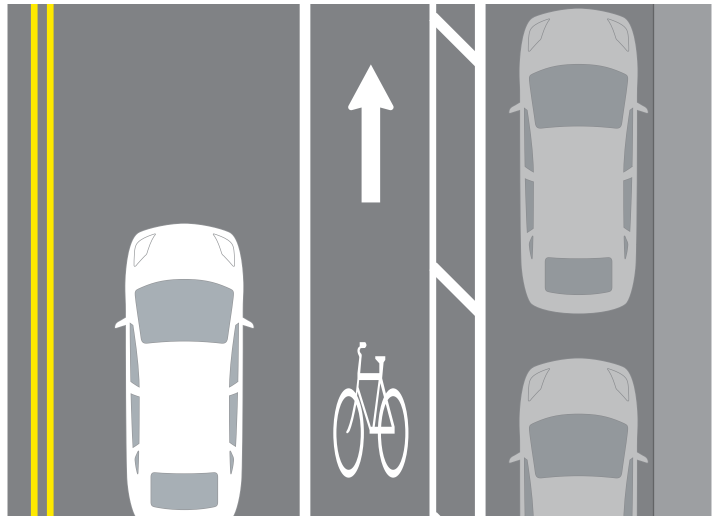
- Due to Burlington's downtown-wide 20 MPH speed limit, it is recommended that the buffer be placed on the side of the parking lane to protect from opening car doors.
- Additional options include: travel-side buffer and split buffer.
- Uphill bike lanes should widen when slope is 4% or greater. (See *"General Bikeway Considerations" on page 141*)
- Use colored pavements to highlight areas where conflicts might occur, such as intersection and driveway crossings.
- Where vehicles merge into the bike lane in advance of a turn movement, lane striping should be dashed from 50 to 200 feet in advance of intersections to the intersection

Dimensions

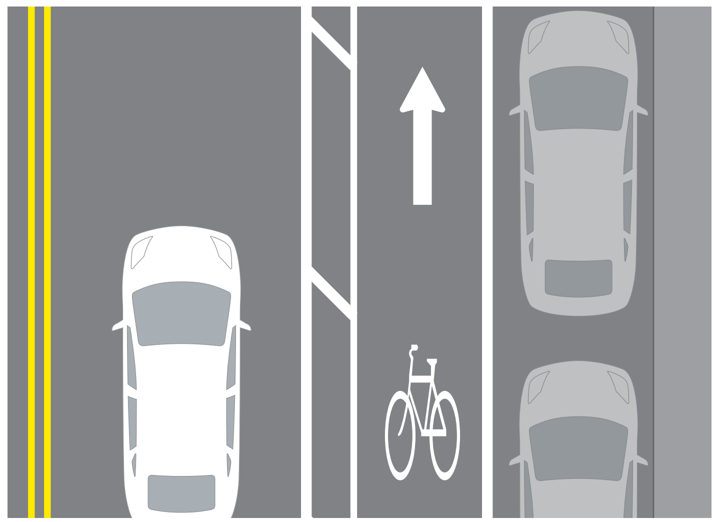
- A 5' minium lane width is recommended to encourage bicyclists to ride outside of the door zone.
- The combined width of the buffer(s) and bike lane should be considered "bike lane width" with respect to guidance given for conventional bike lanes without a buffer. For example, a 5' bike lane and 2' buffer can be considered a 7' bike lane.
- Buffers should be at least 18 inches wide because it is impractical to mark a zone narrower than that

Markings

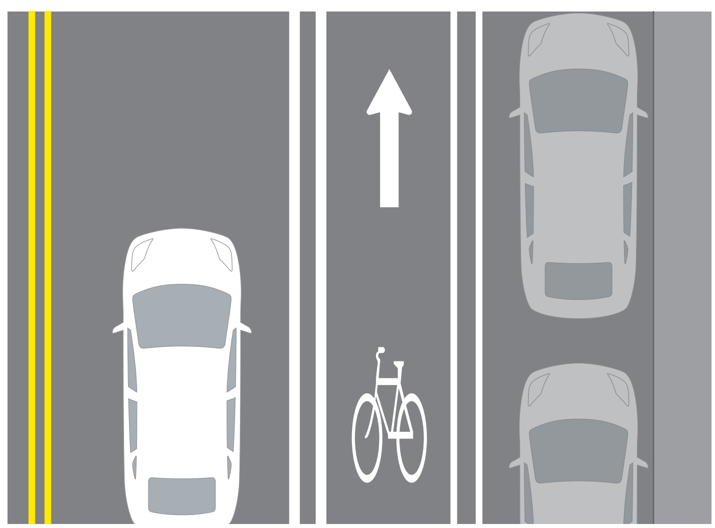
- Bicycle lane word and/or symbol and arrow markings (MUTCD Figure 9C-3) shall be used to define the bike lane and designate that portion of the street for preferential use by bicyclists.
- The buffer shall be marked with 2 solid white lines.
- 4" or 6" white interior line
- 6" white line adjacent to travel lane
- 4" diagonal hatching at 30–40 degrees and 10'–40' spacing if buffer is 3' or wider
- See ref. dwg. **VTrans Standard E-194 Bicycle Pavement Markings and Sign Layout** in *Appendix section A-5.*



Buffered bike lane with buffer adjacent to parking lane (recommended).

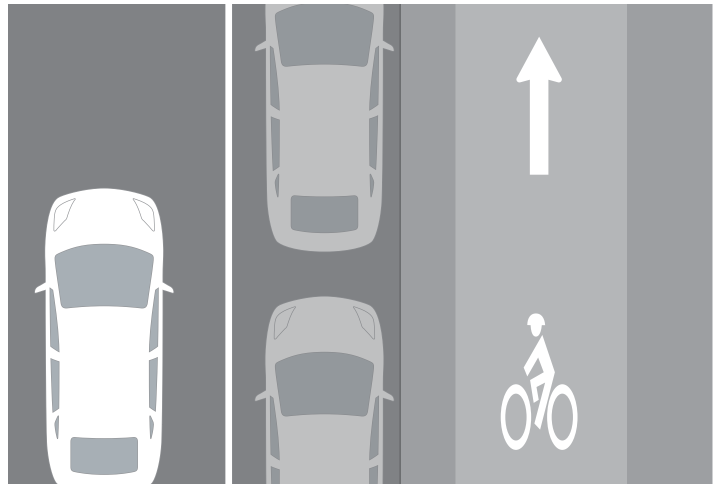


Buffered bike lane with buffer adjacent to travel lane.



Buffered bike lane with buffer on both parking lane and travel lane sides.

Protected Bicycle Lane



Protected bicycle lanes are particularly appropriate on streets that are key corridors for both bicycle and vehicle travel, and where speed, volume, and/or cross-section merit additional protection from vehicular traffic. They are particularly appropriate on streets where fewer curb cuts exist. Protected lanes may be one-way or two-way. Two-way protected lanes are best used when a majority of origins and destinations are on one side of the street (with the bike lane located on that side to reduce the need to cross the street). They can be designed at the same grade of the sidewalk separate from pedestrian travel, at the same grade as the street, physically separated from vehicular travel, or at a grade between the street and sidewalk.

Considerations

- On streets with higher volumes of bicycles, it is preferable to have the protected bicycle lane at the same grade as the sidewalk and Tree Belt/Buffer Zone as it allows easier access to/from the bicycle lanes.
- The buffer between the parked cars and bicycle lanes should be at least 3', and at the same grade as the bicycle lanes.
- There should be a one foot clearance between any fixed object in the Buffer Zone (e.g. parking meter) and the bicycle lanes.
- Wider bicycle lane widths should be used on streets with grades greater than 4%, or where high volumes of bicycles are expected. (See *"General Bikeway Considerations" on page 141*)
- The protected facility should be wrapped around the transit stop zone to reduce conflicts with transit vehicles at midblock or signal protected intersections.
- Bicyclists should yield to pedestrians in crosswalks and bikeways should be designed with the same considerations as vehicular travelways.
- 5' width or greater needed for sidewalk snow plow or sweeper; 10' width or greater needed for small truck plow.
- Two-stage turn boxes at intersections
- Bike signals and/or bike signal phasing should be considered
- Additional care needed on two-way paths at intersections and driveways, as drivers do not expect bicycles in the opposite direction

One-Way

Dimensions

- 7' preferred if bike lane is parking protected or uphill
- 6.5' min. if bike lane is raised
- 5' min. otherwise
- 5’ min. at intersections and pinch points
- 3’ min. painted buffer if the bike lane is parking-protected.
- 3' min. painted buffer with bollards if the bike lane is adjacent to the travel lane and at street grade.
- 1’ min. buffer (at 4:1 slope) if a raised median or curb is used and nothing else is placed in it
- 5” max. vertical separation from sidewalk if bike lane is raised
- 6” max. vertical separation from roadway if bike lane is raised

Markings

- Bicycle lane word, symbol, and/or arrow markings (MUTCD Figure 9C-3) shall be placed at the beginning of a cycle track and at periodic intervals along the facility based on engineering judgment.
- Color, yield lines, and/or signs for conflict areas

Two-Way

Dimensions

- 12' preferred or uphill minimum
- 8' min. on low-volume bicycle routes
- 3' buffer from moving traffic in contraflow direction
- 3’ min. painted buffer if the bike lane is parking-protected.
- 3' min. painted buffer with bollards if the bike lane is adjacent to the travel lane and at street grade.
- 1’ min. buffer (at 4:1 slope) if a raised median or curb is used and nothing else is placed in it
- When vertically separated from roadway, raise bike lane to level of sidewalk—6" typical height (recommended option)
- Additional care needed on two-way paths at intersections and driveways, as drivers do not expect bicycles in the opposite direction

Markings

- Bicycle lane word, symbol, and/or arrow markings (MUTCD Figure 9C-3) shall be placed at the beginning of a cycle track and at periodic intervals along the facility based on engineering judgment.
- Color, yield lines, and/or signs for conflict areas
- Dashed centerlines should be used
- See ref. dwg. **VTrans Standard E-194 Bicycle Pavement Markings and Sign Layout** in *Appendix section A-5.*

Contra-Flow Lane

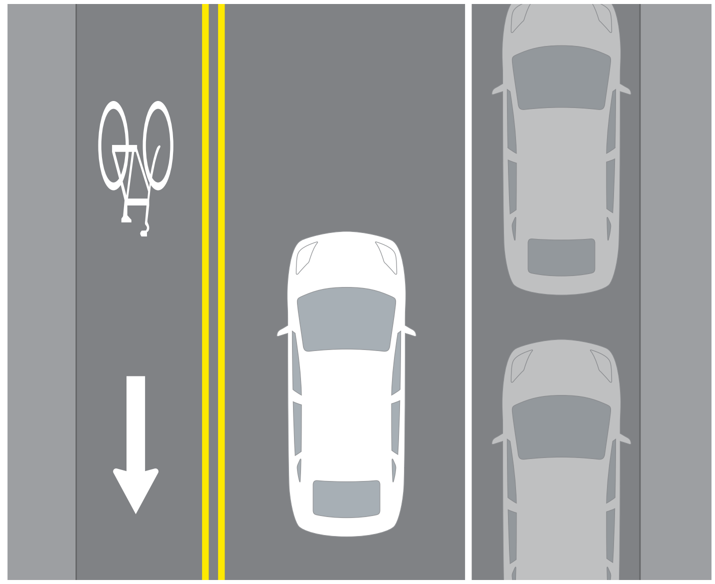


Image source: NACTO Urban Bikeway Design Guide

Contra-flow bicycle lanes are bicycle lanes designed to allow bicyclists to ride in the opposite direction of motor vehicle traffic. They convert a one-way traffic street into a two-way street: one direction for motor vehicles and bikes, and the other for bikes only. Contra-flow lanes are separated with yellow center lane striping. Contra-flow lanes are particularly appropriate on low-speed, low volume streets, unless buffer separation or physical protection is provided.

The contra-flow design introduces new design challenges and may introduce additional conflict points as motorists may not expect on-coming bicyclists.

Considerations

- Guidance for Conventional (*p. 142*) and Buffered (*p. 143, p. 144*) Bike Lanes standards may also apply.
- If sufficient space exists, a buffered bike lane design should be used. The buffer should conform with Figure 3D-4 of the MUTCD. A broken buffer may be used if on-street parking is present.
- A "ONE WAY" sign (MUTCD R6-1, R6-2) with "EXCEPT BIKES" plaque shall be posted along the facility and at intersecting streets, alleys, and driveways informing motorists to expect two-way traffic.
- Intersection traffic controls along the street (e.g., stop signs and traffic signals) shall also be installed and oriented toward bicyclists in the contra-flow lane.
- When configured without parking, a solid double yellow lane line marking should be used to separate opposing motor vehicle travel lanes from the contraflow bicycle lane.
- Where there is room, bike lanes should be used on both sides. When there is no room for a with-flow lane, shared lane markings should be used to guide with-flow bicyclists to keep to the right side of the road.

Recommended on low-speed, low volume streets, unless buffer separation or physical protection is provided.

Dimensions

- **Buffered:** 7.5' total width (5' lane + 2.5' buffer) recommended.
- **Conventional:** 6' width recommended; 7' max.; 5' min.

Consult Conventional (*p. 142*) and Buffered (*p. 143, p. 144*) Bike Lanes standards for additional guidance.

Markings

- Bicycle lane word, symbol, and arrow markings (MUTCD Figure 9C-3) shall be used to define the bike lane direction and designate that portion of the street for preferential use by bicyclists.

Advisory Lane

Where the lateral width of a street prevents the installation of both a conventional bicycle lane and a standard-width travel lane for motor vehicles, advisory bicycle lanes could be an alternative to the shared-lane marking. An advisory lane is similiar to a bike lane, creating a preferential space for people biking. On some streets without sidewalks, advisory lanes may be shared by people walking and biking. The center travel lane is shared by two-way motor vehicle traffic. Drivers enter the advisory lane when necessary to yield to oncoming traffic before passing people bicycling or walking in the advisory lane.

This treatment is currently experimental through the FHWA, but has been applied in Burlington.

Considerations

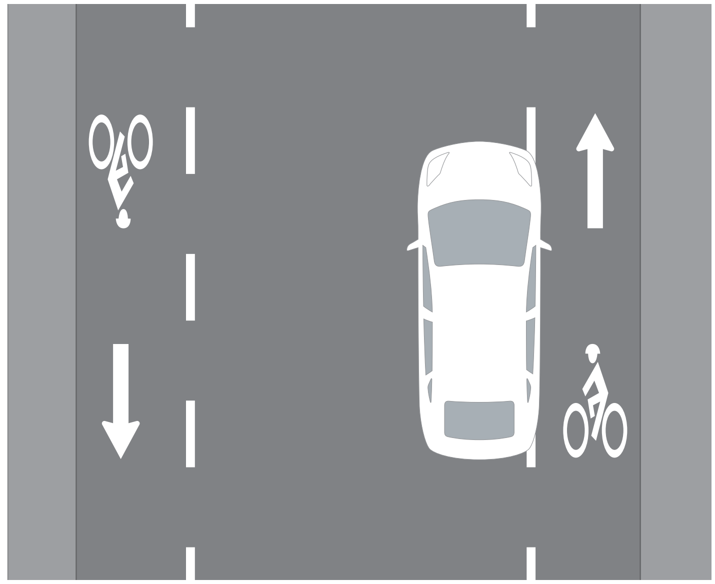
Dashed bicycle lanes can achieve public acceptance and generally be advantageous only where many or all of the following conditions are present:

- Traffic volume is less than 5,000 ADT and speeds are less than 25 MPH.
- The FHWA experimentation guidance suggests a minimum lateral width of 16 feet of the center space dedicated to two-way travel between the dashed advisory lanes. Other experiments are considering applications of 10 to 18 feet for two-way travel lanes.
- The street is not a designated truck or bus route, nor would the street be expected to facilitate these vehicle types to and from other facilities.
- The preferred width of the advisory lanes follow the same guidance as bicycle lane standards in this section.
- Dashed bicycle lanes can be considered on streets either with or without on-street parallel parking.

Markings

The following design elements are required to establish advisory lanes:

- Dashed white lines to indicate the advisory lane.
- Bicycle and/or pedestrian stencils and arrows in the advisory lane.
- Preferred width is 6 ft; 4 ft may be considered in appropriate constrained conditions.
- Bollards or channelizing islands along the dashed line may be considered at periodic spacing to discourage motor vehicle encroachment into the advisory lane.



Advisory lanes utilizing dashed white lines, arrows, and bicycle stencils.

Example of optional bollards and island markings to prevent vehicle encroachment into an advisory lane. (Image source: Alta Planning & Design 2017 Advisory Lane white paper)

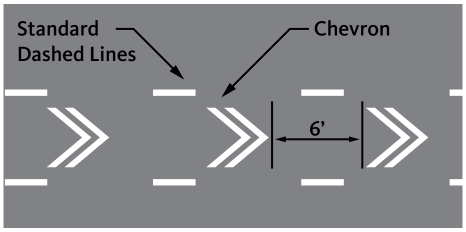
Intersections

Bicycle Crossing Markings

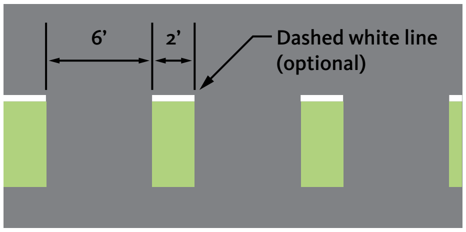
Bicycle crossing markings indicate the intended path of bicyclists. They guide bicyclists on a safe and direct path through intersections, including driveways and ramps. They provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.

- Dotted lines shall bind the bicycle crossing space. Consult MUTCD Section 3B.08 for dotted line extensions through intersections.
- Striping width shall be a minimum of 6" adjacent to motor vehicle travel lanes and shall otherwise match the width and lateral positioning of leading bike lane striping, except when using elephant's feet markings.
- Dotted lines should be 2' lines with 2' to 6' spacing. Markings should be white, skid resistant and retro-reflective.
- Crossing lane width should match width and positioning of the leading bike lane.
- On crossings of two-way paths and cycle tracks, markings should indicate that there is two-way traffic either by marking the path center line through the intersection, or by marking bicycle silhouettes and/or chevrons in opposite directions in the two lanes. See Two-Way Protected Bicycle Lanes (*page 145*).
- Chevrons may be used for increased visibility within conflict areas or across entire intersections. Placement shall be in the middle of the moving lanes, and close to crosswalks.
- Colored pavement may be used for increased visibility within conflict areas or across entire intersections.
- Shared lane markings (MUTCD Figure 9C-9) may be used for increased visibility within conflict areas or across entire intersections. Placement shall be in the middle of the moving lanes, and close to crosswalks.

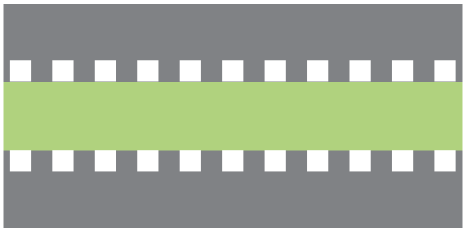
Intersection Marking Types



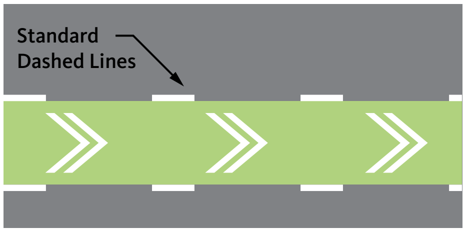
Conventional Crossbike Marking
Apply to a bike lane crossing a low volume street or high volume driveway.



VTrans High-Volume Crossbike Marking
Apply to a bike lane crossing a high volume street or turn lane. In line with crosswalk.



Green Elephant Feet Crossing Marking
Apply to a shared use path or shared bike/ped crossing of a street or commercial driveway.



Green Crossbike Marking
Apply to a neighborhood greenway crossing an intersection.

Through Bike Lanes & Advisory Lanes

For bicyclists traveling in an on-street bike lane, the approach to an intersection with vehicular turn lanes can present a significant challenge. For this reason it is vital that bicyclists are provided with an opportunity to correctly position themselves to avoid conflicts with turning vehicles- a through bike lane is one design tool to do so.

Benefits of Through Bike Lanes

- Enables bicyclists to correctly position themselves to the left of right turn lanes or to the right of left turn lanes.
- Reduces conflicts between turning motorists and bicycle through traffic.
- Provides bicyclists with guidance to follow the preferred travel path.
- Leads to more predictable bicyclist and motorist travel movements.
- Alerts motorists to expect and yield to merging bicycle traffic.
- Signifies an appropriate location for motorists to safely merge across the bike lane into the turn lane.

Typical Applications

- On streets with right-side bike lanes and right-turn only lanes at intersections.
- On streets with left-side bike lanes and left-turn only lanes at intersections.
- On streets with shared lane markings at intersections.

Design Considerations

- The desired width of a dotted bike transition lane and through bike lane is 6 feet with a minimum width of 4 feet.
- Bicycle lane word and/or symbol and arrow markings (MUTCD Figure 9C-3) shall be used to define the bike lane and designate that portion of the street for preferential use by bicyclists.
- The through bike lane shall be placed to the left of the right-turn only lane.
- Dotted lines signifying the merge area shall begin a minimum of 50 feet before the intersection (MUTCD). Dotted lines should begin 100 feet before the intersection if along a high speed/volume roadway.
- Dotted lane line transition areas to through bike lanes shall not be used on streets with double right turn lanes. Double right turn lanes are extremely difficult for bicyclists to negotiate. Shared lane markings may be used in the center of the inside turn lane to designate the preferred path of through bicycle travel.
- Accompanying signage should include R3-7R “Right Lane Must Turn Right” and R4-4 “Begin Right Turn Yield to Bikes” (MUTCD).
- Dotted white lines should be 6 inches wide and 2 feet long with a 2- to 6-foot gap between dashes (MUTCD)
- For intersections that lack the physical width to install a bicycle pocket, a combined bike/turn lane should be used..

Mixing Lane (Combined Bike Lane/Turn Lane)

A combined bike lane/turn lane places a suggested bike lane within the inside portion of a dedicated motor vehicle turn lane. Shared lane markings or conventional bicycle stencils with a dashed line can delineate the space for bicyclists and motorists within the shared lane or indicate the intended path for through bicyclists. This treatment includes signage advising motorists and bicyclists of proper positioning within the lane.

Benefits of Combined Bike Lane/Turn Lane

- Preserves positive guidance for bicyclists in a situation where the bicycle lane would otherwise be dropped prior to an intersection.
- Maintains bicyclist comfort and priority in the absence of a dedicated bicycle through lane.
- Encourages motorists to yield to bicyclists when crossing into the narrow right-turn lane.

Typical Applications

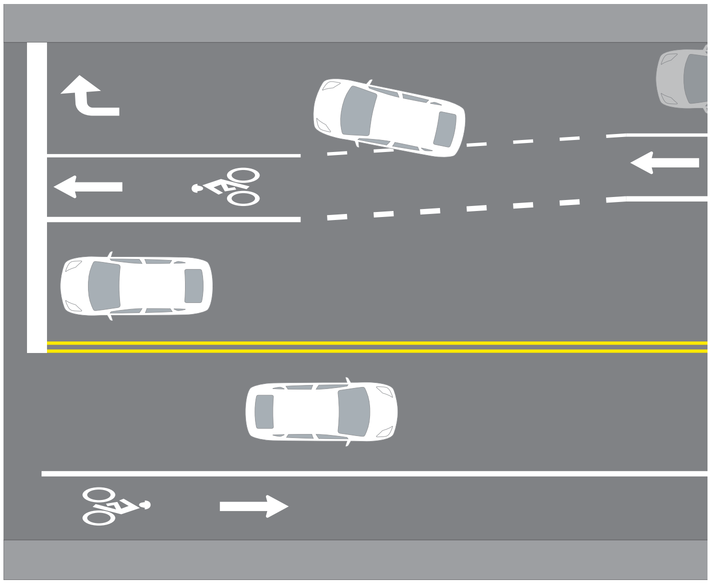
- On streets where there is a right turn lane but not enough space to maintain a standard-width bicycle lane at the intersection.
- On streets where there is no dedicated right turn lane, but on which high volumes of right turning traffic may cause conflicts between motorists and bicyclists.

Design Considerations

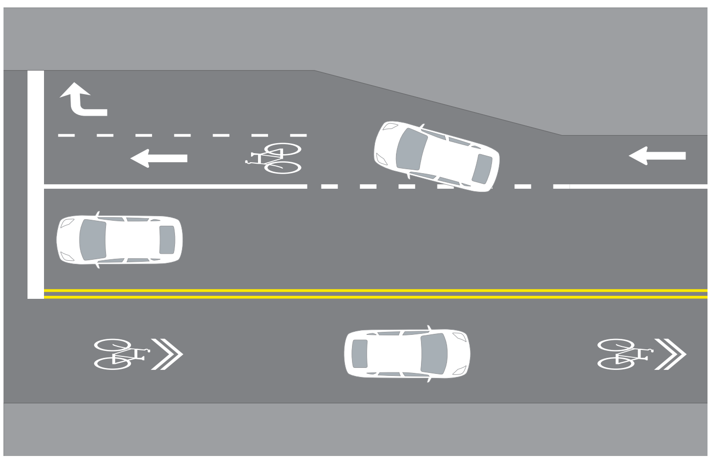
- Some form of bicycle marking shall be used to clarify bicyclist positioning within the combined lane.
- Within the combined lane, the bicycle area width should be 4 feet minimum.
- Width of combined lane should be 9 feet minimum, 13 feet maximum. A full bicycle through lane can be accommodated if the vehicle right turn only lane can be made 14 feet or wider.
- A dotted 4 inch line and bicycle lane marking should be used to clarify bicyclist positioning within the combined lane without excluding cars from the suggested bicycle area.
- A shared lane marking (MUTCD figure 9C-9) may be used as an alternative to dotted striping to clarify bicyclist position within the combined lane.

Additional References

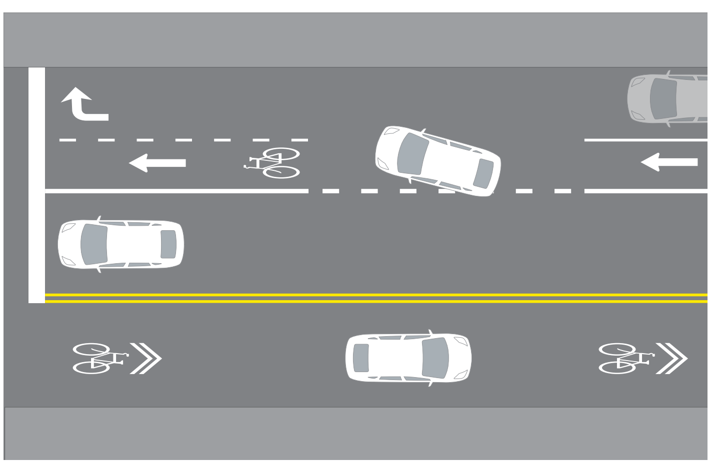
- VTrans Standard Drawings
- City of Burlington Quick Build Design Guide



Through Bike Lane. Not to scale.



Mixing Lane (Combined Bike Lane/Turn Lane). Not to scale.



Mixing Lane (Combined Bike Lane/Turn Lane) with parking lanea. Not to scale.

Protected Intersections

Protected intersections reduce the exposure of bicycle riders to conflicts with vehicles at signalized intersections. Separation from vehicular traffic is increased, and markings clarify the movements for bicycle riders, pedestrians, and vehicles. Raised islands offer protection for bicycles waiting to cross, increase their visibility, and reduce speeds of turning vehicles. Pedestrian and bicycle crossings are often raised to further increase their visibility and reduce vehicle speeds.

Protected intersections are relatively new in the United States, and current design practices are heavily informed by European designs. The design guidelines provided herein should be supplemented by a review of the most up-to-date practices at the time of design.

Benefits

- The roadway crossing distance is shortened by using corner safety islands and a forward stop bar for bicycles.
- Vehicle speeds are lower, providing more reaction time to avoid conflicts and reducing collision frequency and severity.
- Visibility of crossing bicycle riders is increased, as is yielding to crossing pedestrians
- Design provides more clear cues to priority than other treatments such as mixing zones, two-stage left turns, or bicycle boxes.

Typical Applications

Protected intersections should be considered at signalized intersections with a protected bicycle route in at least one direction. The crossing street can have protected, buffered or conventional bike lanes, adapted to be protected through the intersection.

Design Considerations

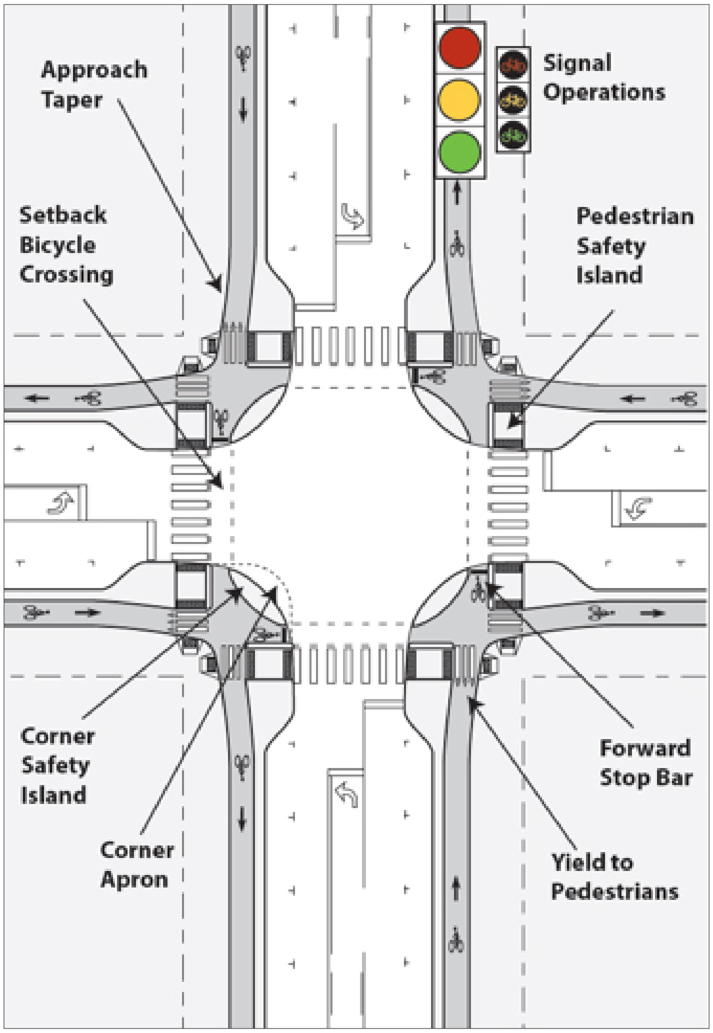
- Design practices and techniques for protected intersections are evolving in the United States. The major elements of a protected intersection include:
- Corner safety islands, that form a protected place for bicyclists to wait to cross
- Forward stop bar for bicyclists that reduce crossing distance and enhanced visibility
- Crossings for bikes and pedestrians that are set back from intersection, allowing greater visibility for turning motor vehicles
- Bicycle signal phasing, which provides an advanced green for crossing and adequate clearance time (see section on bicycle signals for more discussion). Protected intersection signalization may require a longer signal cycle, protected left turn phases, or prohibitions on right-turn-on-reds, which could increase overall delays for vehicles.

Additional Resources

Guidance on the design of protected intersections is rapidly evolving, and available at the following sources:

- www.protectedintersection.com (Alta Planning + Design website sharing information)
- MassDOT Separated Bicycle Lane Planning and Design Guide (Toole Design Group; provides a section on protected intersection design)

Protected Intersections Features and Dimensions

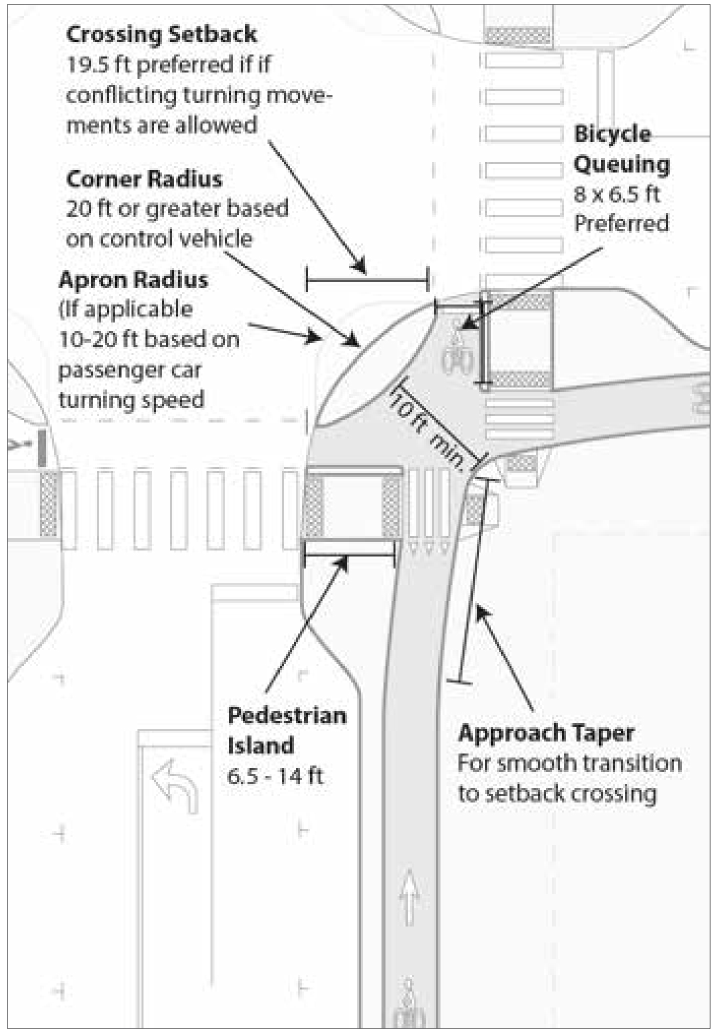


Visual illustration of key protected intersection features

Corner safety islands have multiple roles: offering a protected place for bicyclists to queue when crossing and turning, and managing the speed of turning vehicles when permitted turn conflicts are allowed.

Special attention should be paid to the amount of eflection required for both pedestrians and bicycles in advance of the intersection.

(Image source: Evolution of the Protected Intersection: Lessons Learned, Alta Planning + Design, December 2015)

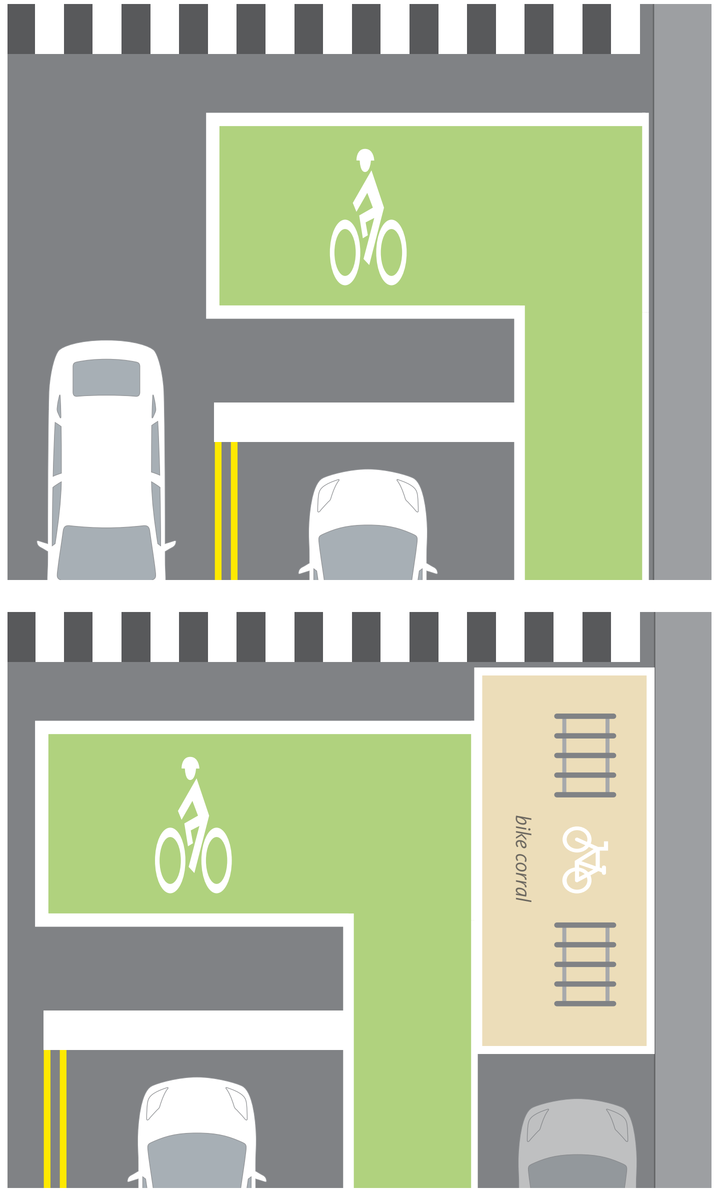


Basic geometric elements and key dimensions of a Protected Intersection

(Image source: Evolution of the Protected Intersection: Lessons Learned, Alta Planning + Design, December 2015)

Bicycle Boxes

A bike box is a dedicated area for bike riders to wait in the traffic lane at a signalized intersection, between the pedestrian crosswalk and the vehicle stop bar. They provide assistance for bicycles approaching an intersection during a red light, but not a green light, so not all conflicts are addressed. A bicycle desiring to make a left turn, and enter the bike box in front of the left turn lane, may need to wait for a red signal to enter the left turn lane bike box.



Bike box at a signalized intersection with a bike lane approach.

Considerations

- Bike boxes should be used at signalized intersections with high volumes of bicycles and/or motor vehicles, especially those with frequent bicyclist left-turns and/or motorist right-turns, and where there may be right or left-turning conflicts between bicyclists and motorists.
- Bike boxes may be combined with an exclusive bicycle signal phase or leading bicycle interval through the use of bicycle signal heads to allow clearance of the bicycle queue prior to the green indication for motorists.
- If a shared lane is narrow, the bike box may not be well utilized as it may be difficult for bikes to move around queued vehicles to enter bike box.
- Generally used with shared, conventional, or buffered bike lanes. Protected bike lanes may use protected intersection design (*page 152*).
- A “Yield to Bikes” sign should be post-mounted in advance of and in conjunction with an egress lane to reinforce that bicyclists have the right-of-way going through the intersection.
- A "No Turn on Red" sign shall be installed overhead to prevent vehicles from entering the bike box at signalized instersections.
- A “Stop Here on Red” sign should be post-mounted at the stop line to reinforce observance of the stop line.
- A “WAIT HERE” legend marking may be used to supplement the stop line and “Stop Here on Red” sign.

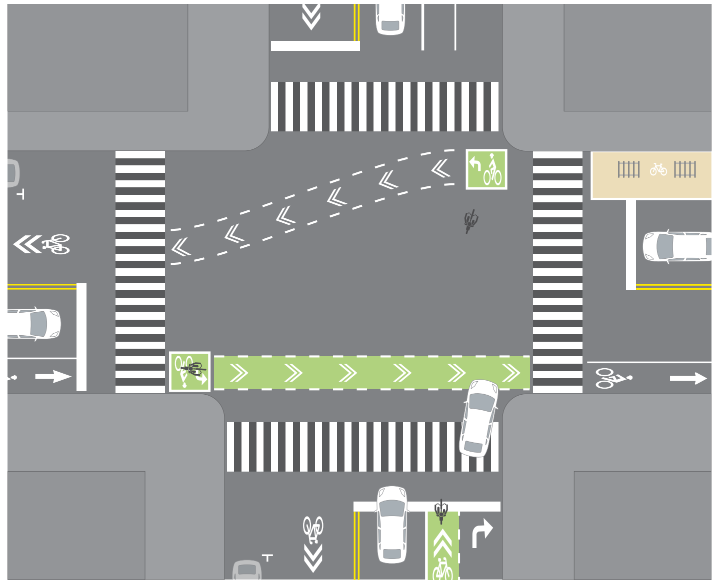
Dimensions

- A box formed by transverse lines shall be used to hold queuing bicyclists, typically 10–16 feet deep; the area between them across the full width of the approach.

Markings

- Stop lines shall be used to indicated the point behind which motor vehicles are required to stop in compliance with a traffic control signal. See MUTCD 3B.16.
- Pavement markings shall be used and centered between the crosswalk line and the stop line to designate the space as a bike box. The marking may be a Bike Symbol (MUTCD 9C-3A) or Helmeted Bicyclist Symbol (MUTCD 9C-3B).
- Colored pavement should be used as a background color within the bike box to encourage compliance by motorists.
- An ingress lane should be used to define the bicycle space. Colored pavement may be used. When color is used, length shall be 25 to 50 feet to guarantee bicycle access to the box.
- An egress lane should be used to clearly define the potential area of conflict between motorists and bicyclists in the intersection when intersection is operating on a green signal indication.
- Stop lines may be placed up to 7 feet in advance of the bike box space to limit encroachment by motor vehicles.

Two-Stage Left Turn Boxes



Two stage left turn markings are used at signalized intersections, and allow a left turning bicyclist to turn without weaving across traffic into a left turn lane. The markings provide a designated place for a left turning bicyclist to wait outside of the vehicle traffic paths for a signal to change. The markings provide more formal guidance for bicyclists making left turn maneuvers, which can be a challenge for a less experienced rider. Cyclists are not required to use the two-stage left turns, and more confident riders will often chose to make their left turn from the vehicle traffic lane. Two stage left turns will delay cyclists as they must wait for the cross street green signal.

Considerations

Should be used at signalized intersections along multi-lane roadways with a high traffic speeds and/or traffic volumes | Where a high number of bicyclists turn left from a right side bikeway, especially along cycle tracks.

- “No Turn on Red” sign shall be installed overhead to prevent vehicles from entering the queuing area. (MUTCD Section 2B.54)
- Two-stage queue box shall be placed in a "protected area," typically in line with an on-street parking lane or between the bicycle lane and crosswalk.
- A two-stage left turn box may also be used at unsignalized intersections to ismplify turns from a bicycle lane onto a neighborhood street.
- Multiple positions are available for queueing boxes, depending on intersection configuration

Dimensions

- 7' × 7' minimum square

Markings

- Bicycle stencil and turn arrow to clearly indicate proper bicycle direction and positioning
- Bicycle stencil 40" × 72"
- 6" retroreflective solid border (recommended)
- Green traffic paint, MMA, or Ruby Lake Glass (recommended)

Bicycle Signals

Bicycle signals are used in combination with an existing conventional traffic signal or hybrid beacon to provide guidance for bicyclists for bicycle only movements or leading bicycle intervals. They use standard three-lens signal heads with green, yellow, and red lenses.

Benefits

- Separates bicycle movements from conflicting motor vehicle, transit, or pedestrian movements, which may improve real and perceived safety at high-conflict areas.
- Provides priority to bicycle movements at intersections (e.g., a leading bicycle interval).
- Accommodates of bicycle-only movements within signalized intersections (e.g., providing a phase for a contra-flow bike lane that otherwise would not have a phase). Through bicycle travel may also occur simultaneously with parallel auto movement if conflicting automobile turns are restricted.
- Helps to simplify bicycle movements through complex intersections and potentially improve operations or reduce conflicts for all modes.

Typical Applications

- Bicycle signals are typically used at major intersections of bikeways with motor vehicle routes. The bikeways may be protected bike lanes or shared use paths, or conventional bike lanes that are adapted to be protected bike lanes through the intersection.
- The need for a bicycle signal should consider volumes of bicyclists, potential for conflicts or crash history, and vehicular traffic patterns. Bicycle signals should be considered for intersections with more than 50 bicycles in one direction during a peak hour combined with 1,000 or more peak hour vehicles passing through the intersection (all directions). (Many downtown Burlington intersections would likely meet these criteria.)
- Bicycle signals can be used for contra flow bike lanes at signalized intersections, where the traffic signal does not provide any guidance for the contra flow bike traffic.
- Bicycle signals can also be used to allow bicycle traffic during an all-way pedestrian scramble signal phase.

Design Considerations

- Bicycle signal phases may increase the signal cycle length and increase traffic delay.
- Consideration should be given to the number of right-or left-turning vehicles that may be crossing the path of a protected bike lane crossing, which may be addressed by separate signal phases for the bicycle traffic and turning vehicle traffic. If there are exclusive turn lanes, signal phasing can be adapted to prohibit the vehicle turns during the bicycle phase. Otherwise, permissive turns must yield to bicycles in the crossing.
- The bicycle clearance interval should be established considering the "design speed" of the bicycle traffic (often around 10 MPH), and the crossing width, using a formula:
  - $C = 3 + W/V$, where C = clearance interval; W = width of crossing in feet; and V = design speed of bicycles in feet per second (1.5 times the speed in MPH, or typically 14 ft/sec)
- The bicycle signal does not apply for bicycles who are riding in traffic lanes. They must obey the vehicular traffic signal.
- Detection for bicycles may be required, depending on the type of signal actuation or recall. Detectors can be video cameras or a magnetic loops.

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Bikeways at Bus Stops

Shared Bicycle and Bus Lanes

As the popularity of biking as an alternative mode of transportation increases in Burlington, and more on-street bike infrastructure is added, it is critical to address the relationship between bicycle accommodations and bus stops. In older cities like Burlington, right-of-way constraints often do not allow high-comfort bicycle facilities and bus stops/ bus lanes to be provided within the same right-of-way. Several shared bicycle and bus stop/bus lane marking options may be used to provide increased space and visibility for users of both modes while improving transit reliability. Shared infrastructure also provides visual continuity and clear lateral placement along streets where speeds are low and bus headways are longer than 4 minutes.

Application Guidance

Applications

Bu/bikeway network overlap.

Components

- White retroreflective traffic paint, thermoplastic, or traffic tape markings (required)
- Terracotta and green traffic paint, MMA, or Ruby Lake Glass (recommended)

Dimensions

- Curbside bus layovers and bus lanes should be a maximum of 11' in width.
- To accomodate 40' buses, bus layovers should be a minimum of 90' in length.

Design Guidance

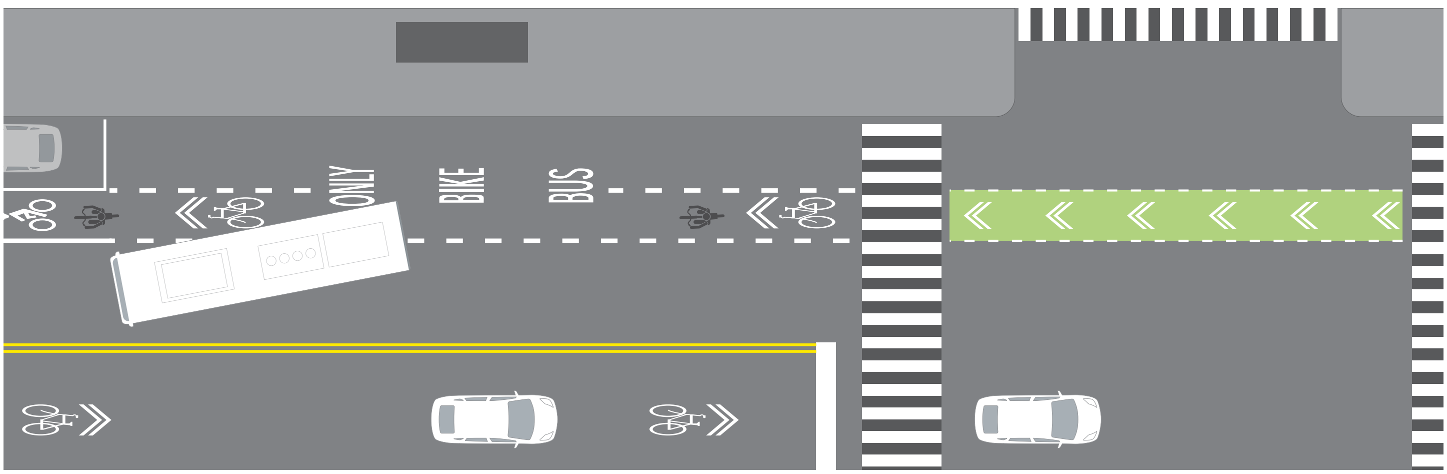
- Completely separate bus and bikeway facilities are always preferred over shared lanes or layover zones. Bus/bike lanes and bus-bike layovers should not be considered a substitute for dedicated bikeways, particularly at peak periods and on high-volume bus routes. If sharing poses real problems, emphasizing parallel neighborhood greenways or the removal of parking are two ways to separate the modes.
- To minimize conflict and resulting discomfort, bicycle/bus layover and bicycle/bus lane combos should generally be limited to streets where operating speeds average 20 MPH or less, and transit headways average every four minutes or longer.
- All bus lane pavement markings must state that the lane is dedicated to transit, including a solid white line and a "BIKE BUS ONLY" marking.
- Bus-bike lanes may be wider than the above recommended width if it allows people bicycling to overtake stopped buses on the left. This condition should include a standard dashed line and sharrow pavement marking be placed on the left edge of the bus layover, typically 9' feet from the curb face to indicate to bicyclists where to pass.In some situations adjacent travel lanes may be narrowed approaching bus stops so that a bicyclist passing zone is permitted.
- Shared use lane markings should be located in the center of the bus lane and on the left side of the bus layover at a transit stop.
- Shared bus-bike lanes can be applied where parking lanes at off-peak times.

Additional Reference

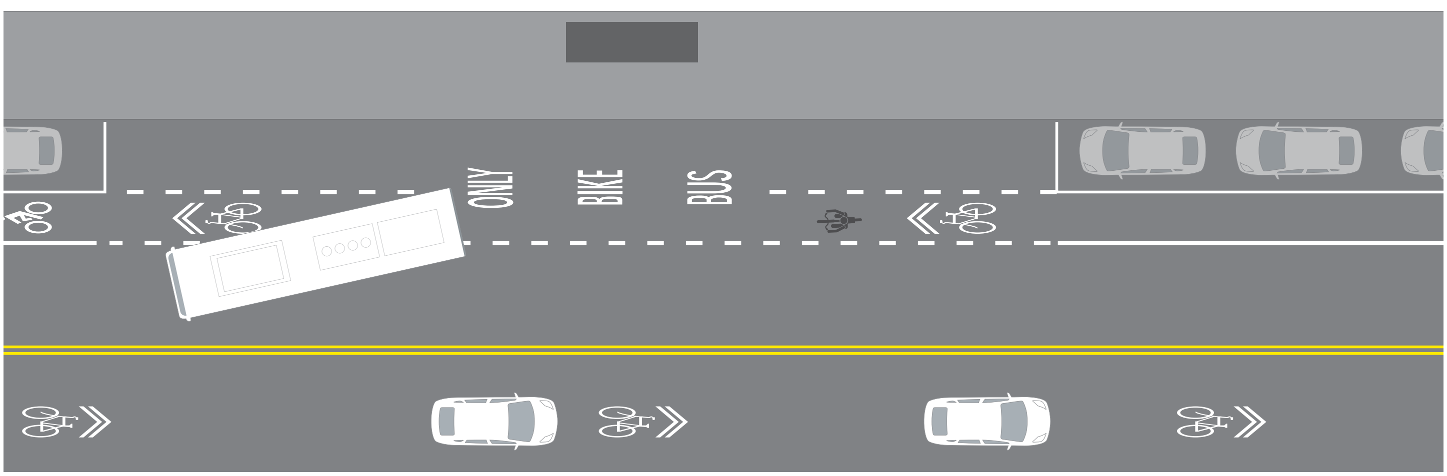
See NACTO's Urban Bikeway and Transit Street Design Guides for more details.

Curbside Bus Stop with Bike Lane Adjacent to Parking Lane

- Bike lane can be either coventional or buffered.
- Bus stop curbside next to on-street parking is the most common stop configuration.
- Uses bus queue jump at a signalized intersection in conjunction with a far-side stop.
- Bus queue jumps can be combined with bikes, and right turns.
- Bus queue jumps can be used exclusively by buses, but if curbside there must be signal control to prevent right turns in front of the bus, or right turns should be banned.
- Exclusive bus queue jumps can be set up between an exclusive right turn lane curbside, and travel lane(s) for other movements.
- Bus queue jump ideally used in conjunction with transit signal priority.
- Bike box to be determined on site specific basis: added benefit when buses are not present on the approach.



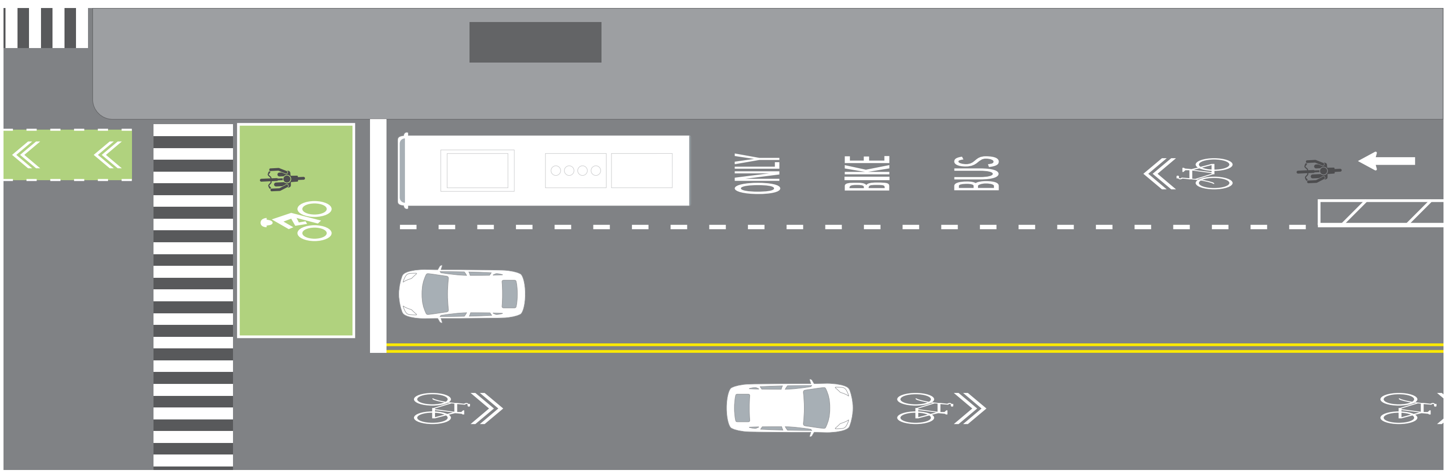
Bus stop and conventional bike lane at intersection. Can also be used with buffered bike lane adjacent to parking. (Not to scale)



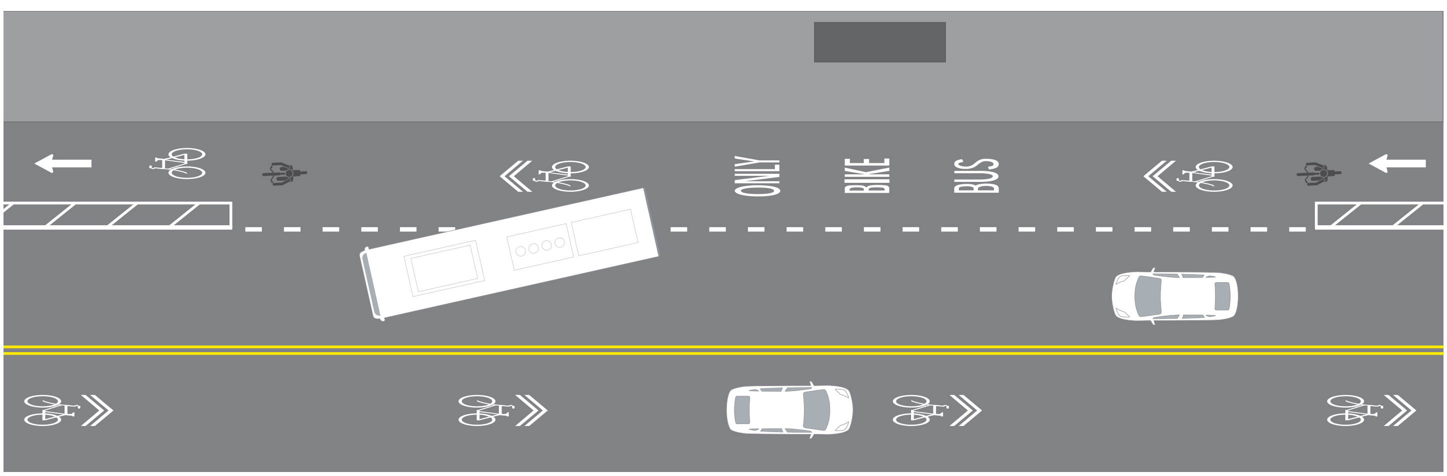
Bus stop and conventional bike lane at mid-block. Can also be used with buffered bike lane adjacent to parking. (Not to scale)

Curbside Bus Stop with Buffered Bike Lane Adjacent to Curb

- Use when bus stop is shared with bike lane.
- Stopped buses block through access for bicyclists.
- Buffered separated bike lane provides more protection for bicyclists than conventional on-street bike lane.



Bus stop and buffered bike lane at intersection. (Not to scale)



Bus stop and buffered bike lane at mid-block. (Not to scale)

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Markings, Signage & Materials

Bikeway Markings

Markings indicate the separation of the lanes for road users, assist the bicyclist by indicating assigned travel paths, indicate correct position for traffic control signal actuation, and provide advance information for turning and crossing maneuvers.

Line Width

6" normal white line

Word/Symbol/Arrow

A range of bikeway markings will help make Burlington's bicycle network more legible and intuitive for cyclists, as well as other roadway users. These symbols can be found on the following page.

Additional reference: MUTCD Figure 9C-3: Word, Symbol, and Arrow Pavement Markings for BIcycle Lanes

Colored Bike Lane

Colored pavement within a bicycle lane increases the visibility of the facility, identifies potential areas of conflict, and reinforces priority to bicyclists in conflict areas and in areas with pressure for illegal parking. Colored pavement can be utilized either as a corridor treatment along the length of a bike lane or cycle track, or as a spot treatment, such as a bike box, conflict area, or intersection crossing marking. Color can be applied along the entire length of bike lane or cycle track to increase the overall visibility of the facility. Consistent application of color across a bikeway corridor is important to promote clear understanding for all users.

The color green shall be used to minimize confusion with other standard traffic control markings. **The specific color of green varies depending on manufacturer.** The color shall comply with MUTCD daytime and nighttime chromaticity coordinates, according to FHWA memorandum "Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14)."

Color shall be applied to the road surface to delineate space, increase visibility, and emphasize proper vehicle priority.

Normal white bike lane lines shall be provided along the edges of the colored lane to provide consistency with other facilities and to enhance nighttime visibility.

Additional References

VTrans ref. dwg. Standard E-194 Bicycle Pavement Markings and Sign Layout in *Appendix section A-5.*

Urban Bikeway Design Guide: National Association of City Transportation Officials (NACTO)

Burlington Quick Build Design + Materials Standards

Signage

Follow MUTCD standards (Section 9B.01—Application and Placement of Signs), including mounting height and lateral placement from edge of path or roadway.

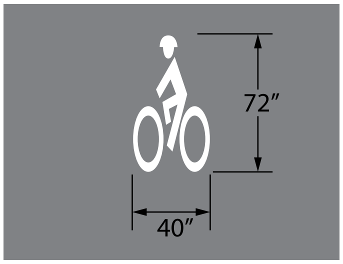
Additional References

VTrans ref. dwg. Standard E-131B Bicycle Guide Sign Details in *Appendix section A-5*

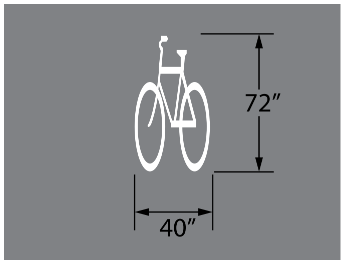
Vtrans ref. dwg. Standard E-194 Bicycle Pavement Markings and Sign Layout in *Appendix section A-5*

MUTCD Section 9B.20—Bicycle Guide Signs

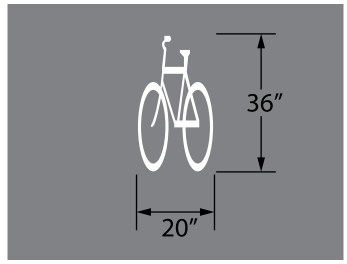
Bikway Markings Details



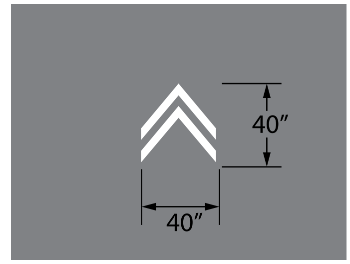
Bike Symbol



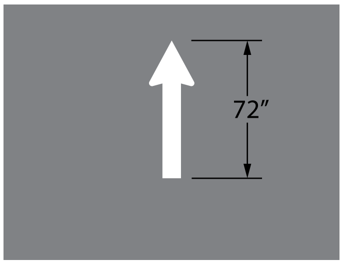
Bike Symbol



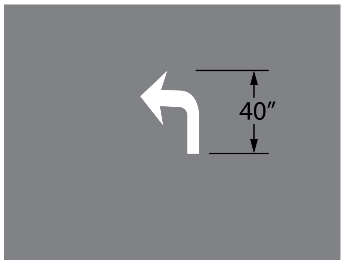
Mini Bike Symbol



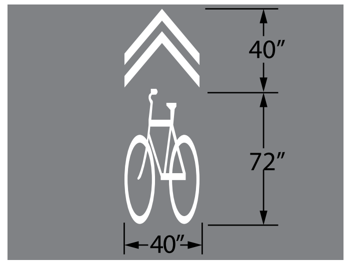
Chevron



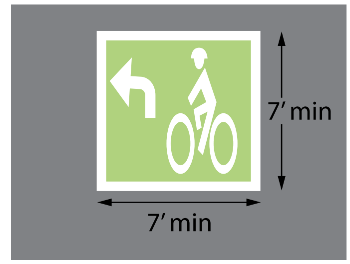
Directional Arrow



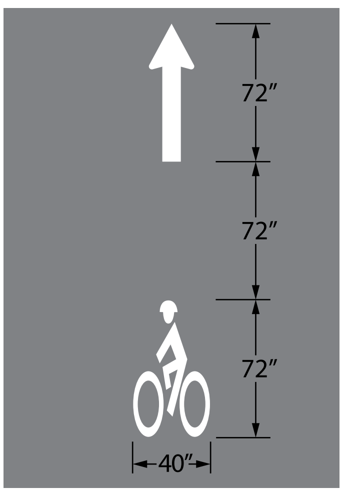
Directional Turn Arrow



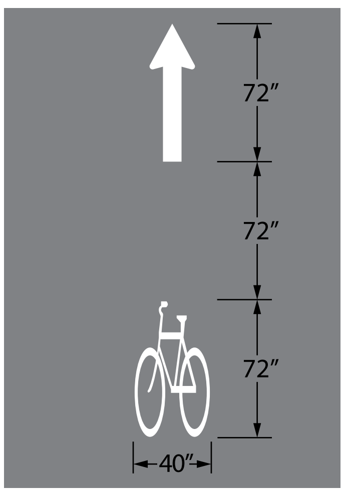
Sharrow



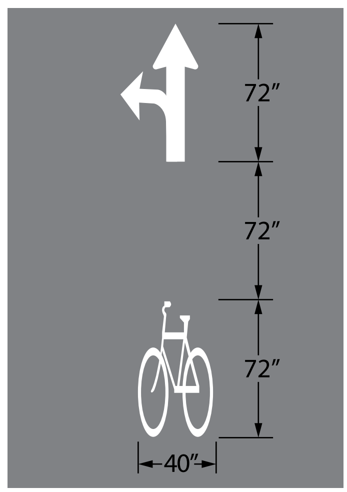
Two-Stage Queue Box



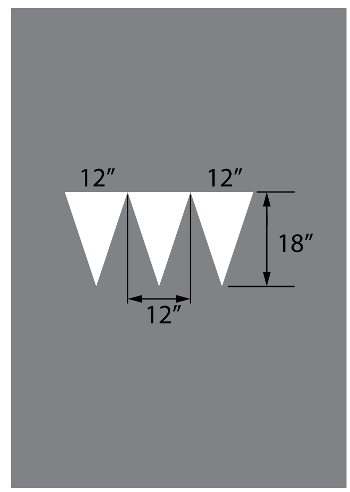
Bike Lane Symbol



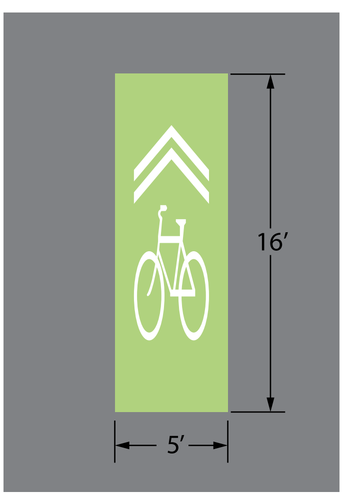
Bike Lane Symbol Alternative



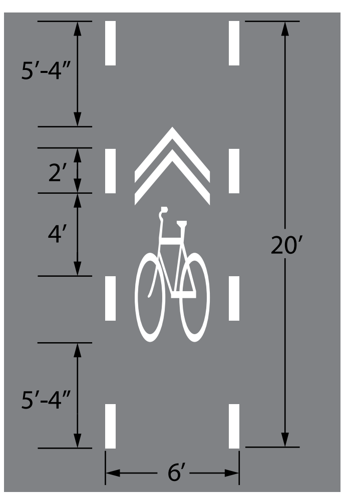
Bike Lane Turn Ahead



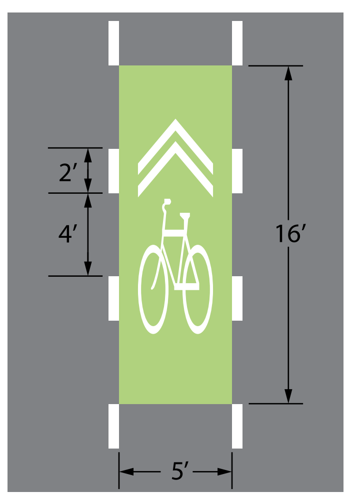
Yield Lines



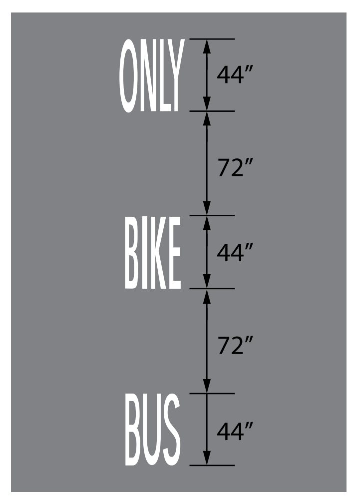
Green Backed Sharrow



Super Sharrow



Green Backed Super Sharrowa



Bus Bike Only Lane Marking

Colored Pavement Materials

Colored pavement can be utilized either as a corridor treatment along the length of a bike lane or cycle track, or in limited locations as a spot treatment, such as a bike box, conflict area, or intersection crossing marking. Colored pavement for use within bikeways treatments may take the form of an overlay, when the colored material is placed on top of the pavement or embedded, when the colored material is mixed into the pavement.

PAINT

Paint, sometimes with additives such as reflective glass beads for retro reflectivity and sand for skid resistance, is the most widely used method to mark road surfaces. Paint is considered a non-durable pavement marking, is easily worn by vehicle tires and the elements in snowy winter climates, and often requires annual reapplication. Paint is the least expensive of the overlay materials.

Spot Treatments Recommended for temporary, pilot, or experimental spot treatments.	**Pros** Easy application and moderate dry time. **Cons** Proven to wear quickly in areas with moderate to heavy motor vehicle traffic.
Corridor Treatments Recommended for corridor treatments. Ideal for protected bicycle facilities like cycle tracks.	**Pros** Cost-effective along corridors with low or no motor vehicle traffic impacts. **Cons** Can be slick when wet. Not durable in high wear locations.
Composition	Pigment and binder, glass beads and/or a fine aggregate can be added for retroreflectivity and skid resistance.
Installation Considerations	Most paints can be applied immediately to new asphalt or concrete. Primer is not required on concrete roadways. Paint dry time depends on ambient temperature.
Maintenance Considerations	Spot maintenance requires a simple reapplication of paint.
Longevity	Six months to two years based on weather, motor vehicle traffic and snow removal operations (if applicable).
Skid Resistance & Retroreflectivity	Glass beads may be added to paint for retroreflectivity and sand added for skid resistance.

DURABLE LIQUID PAVEMENT MARKINGS (DLPM)—EPOXY AND MMA

Durable Liquid Pavement Markings (DLPM) include epoxy and Methyl Methacrylate (MMA). Epoxies are adhesive, waterborne acrylics that are typically applied as a paint or spray. MMA are 2-part liquids comprised of a resin and activator. While both coatings can be skid resistant, retro reflective and can adhere to concrete or asphalt surfaces, epoxies are sensitive to moisture and temperature and may require long dry times. MMA may be installed at any temperature, is durable and dries quickly, but is more expensive than epoxy.

Spot Treatments MMA is more appropriate for spot treatments than epoxy.	**Pros** Material is durable if installed according to manufacturer specifications. MMA has quick dry times and good durability. **Cons** Epoxy can have long dry times, causing increased disruption to roadway traffic. Requires special installation equipment.
Corridor Treatments Recommended for corridor treatment.	**Pros** Materials are long-lasting and can be cheaper than thermoplastic. **Cons** Requires special installation equipment
Composition	Epoxy—epoxy/resin MMA—acrylic-based resin
Installation Considerations	Installation generally requires special equipment. Epoxy dry time increases as temperature decreases. Dry time is measured in hours. MMA dries in about one hour.
Maintenance Considerations	Some cities have reported that epoxy color intensity fades over time due to color instability under ultraviolet lighting (sunlight) exposure. Pooling water can reduce material longevity.
Longevity	Similar to thermoplastic. Poor pavement quality impacts treatment longevity.
Skid Resistance & Retroreflectivity	Material can be skid resistant and retro reflective.

THERMOPLASTIC

Thermoplastic, another type of durable pavement marking, is a type of plastic made from polymer resins that becomes a homogenized liquid when heated and hard when cooled. Thermoplastic can be pre-formed in specific shapes, such as tiles that can be assembled like a puzzle to color bicycle facilities. Thermoplastic can also be used for bicycle lane symbols, arrows, pavement legends and shared lane markings.

Thermoplastic tends to last longer than epoxy and is easier to apply then MMA. Retro reflective and anti-skid materials can be applied or mixed throughout the plastic.

Spot Treatments Recommended for spot treatments. Ideal for intersection treatments and other high-traffic conflict areas.	**Pros** Quick cure time minimizes traffic impact. Relatively low-cost equipment investment. Easy spot maintenance. Shown to wear well in conflict areas. **Cons** May be cost-prohibitive for large scale applications.
Corridor Treatments Not recommended for long corridors due to cost.	**Pros** Material is known to have long life and good performance qualities in the US and Europe **Cons** Cost-prohibitive in corridor applications.
Composition	Polymer resin, pigment, glass beads, and filler.
Installation Considerations	Many thermoplastics can be applied immediately to new asphalt, but new concrete must cure at least 30 or longer days prior to installation. Primer is typically required for application to concrete roadways and may assist with adherence on older asphalt surfaces. Cure time is measured in minutes.
Maintenance Considerations	Spot fixes are simple: a small piece of plastic is torched into place. Thermoplastic can be recessed to make edge flush with pavement or tamped down to form a seal with the roadway to reduce likelihood of snow plow impact.
Longevity	Average of 5 years, or 3 times the lifetime of paint under the same conditions. Many installations have lasted significantly longer. Poor initi al pavement quality shortens lifespan.
Skid Resistance & Retroreflectivity	Material can be skid resistant and retroreflective. Most effective materials will mix corundum and beads throughout materials rather than top coating material.

COLORED ASPHALT

Colored asphalt is composed of the same material as standard asphalt, but has a colored pigment added. The colored asphalt may be installed as a thin layer over conventional asphalt to reduce cost. Green pigment options are available.

Spot Treatments Recommended for Corridor treatments.	**Pros** Not recommended due to complexity of paving operations. **Cons** Spot maintenance is difficult and may result of color loss when trenching occurs. Requires equipment and expertise to install.
Corridor Treatments Recommended for corridor treatments.	**Pros** Long lasting treatment. Should be coupled with initial construction or repaving for cost savings. Has same lifespan of standard asphalt. Proven long-term use as an effective treatment in Europe. Requires little maintenance **Cons** Requires cleaning of machinery or maintenance of special machinery for colored applications. Colored asphalt is not retroreflective by itself; a white thermoplastic stripe may be used for visibility. Can require special attention at joints between colored and standard asphalt.
Composition	Bituminous pitch, sand/gravel, and pigment.
Installation Considerations	Standard paving considerations apply.
Maintenance Considerations	It is expected that colored asphalt at least 1 cm thick will last for the life of the pavement.
Longevity	Based on motor vehicle traffic, but typically similar to conventional asphalt.
Skid Resistance & Retroreflectivity	Skid resistance equal to uncolored asphalt. Asphalt is not retroreflective.

Green pigment colored pavement options are available.


GOODYEAR

5 Street Ecology

Street Trees

Tree Belts

Street trees can be used to serve a variety of ecological and urban design functions. Based on their location, arrangement, and spacing trees can:

- Provide needed shade and filtered light
- Capture and reduce the velocity of stormwater, and provide treatment of runoff from urban landscapes
- Provide carbon sequestration, improving air quality and meeting goals of the City's *Climate Action Plan*
- Provide food and nesting resources for wildlife, such as birds and pollenators
- Create a sense of enclosure that frames, defines, and accentuates spaces
- Add texture, delight, and human scale
- Lend other human health and wellness benefits

Iconic plantings of street trees associate neighborhoods with seasons, and contribute to a unique sense of place. Trees are an ideal form of shade, providing protection on hot summer days while allowing heat and light to penetrate during cold winter months. They are considered to be the lungs of the City and preserving and expanding the street tree system is an important strategy in the *Climate Action Plan*.

They can also calm traffic by narrowing the apparent width of the roadway. Street trees should be used in thoughtful compositions that respect the overall street context, local environment, and adjacent land uses. Trees offer tremendous economic value by making places more attractive and inviting, thus adding to the vitality of commercial areas and to the value of private properties.

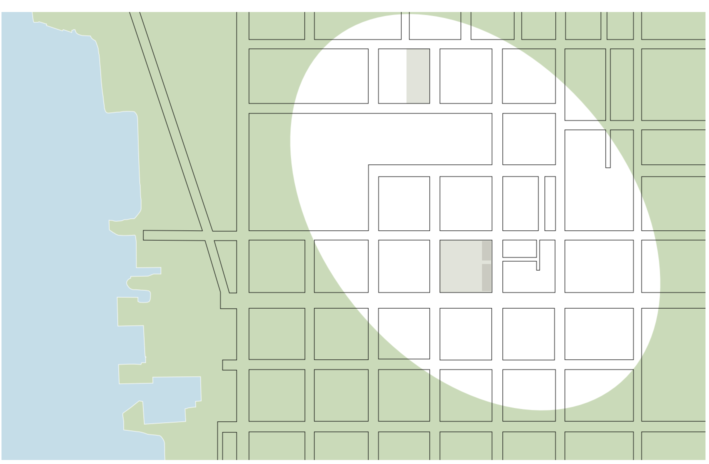
Street trees with robust canopies and root systems also provide stormwater management benefits. Their canopies slow stormwater on its way to drainage systems and their roots filter and absorb stormwater as it soaks into the ground. Street trees also create habitat for urban wildlife through their leaves, seeds, ands structure. An investment in trees as part of street reconstruction projects will lead to a greater realization of benefits over time as trees mature.

Biodiversity

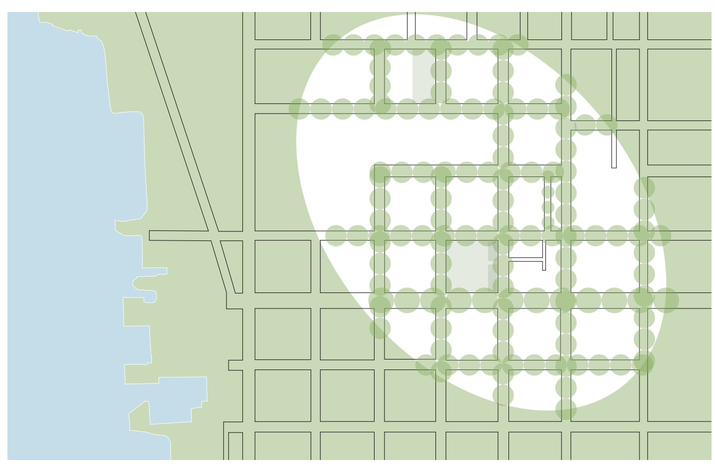
A mixed planting of trees from the approved species list is desired to give each block its own identity and yield a more resilient tree canopy in Downtown Burlington. Diseases, pests, pedestrian and vehicle traffic all pose threats to urban trees. In the early 1900s, Burlington's downtown character was defined by the grandeur of thousands of American Elms. By 1980, nearly all of them had succumbed to Dutch Elm Disease. By planting a diversity of species, the risk of a repeated failure of this magnitude is mitigated.

Snow & Salt

Snow and ice management is critical to maintaining downtown Burlington's accessibility during the winter months. Shovels, plows, and salt, however create a suboptimal environment for growing healthy street trees to maturity. Street tree plantings in downtown Burlington must be designed for maximum resilience in this environment—without compromising on pedestrian safety. Tree guards, which are plow and salt-resilient, will be used to protect trunks from plow and shovel strikes.

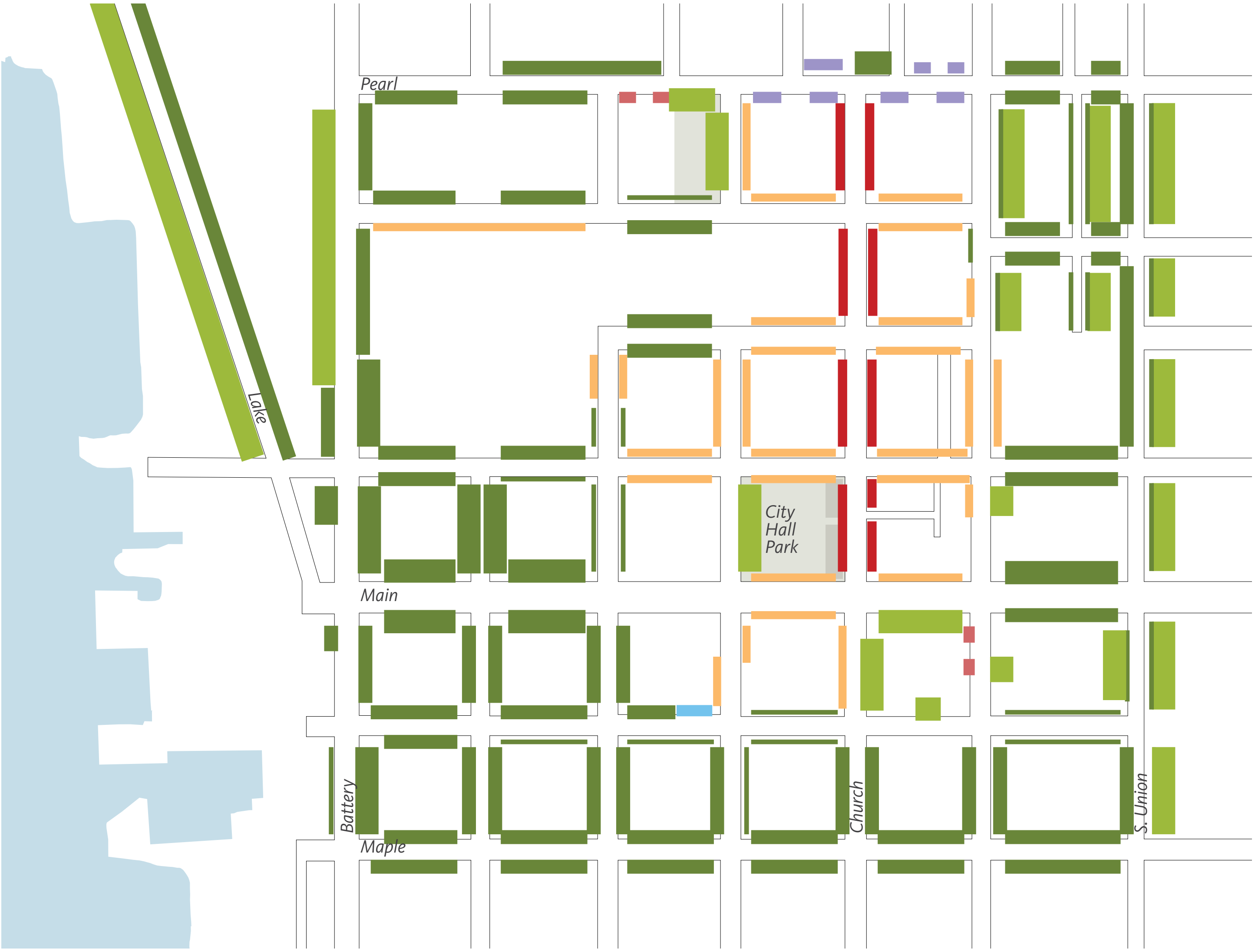


While the area surrounding Burlington is lush and green, canopy coverage is severely limited downtown in areas of high pedestrian activity.



Burlington has the opportunity to invite the canopy back into the downtown. By incorporating green infrastructure and adequate soil volumes which are outlined in these standards, Burlington can weave trees throughout the downtown rights-of-way in ways not previously achievable.

Existing Tree Belt Conditions



- **Lawn (behind sidewalk/private property)**
- **Broad Green Belt (>12')**
- **Standard Green Belt (5'-12')**
- **Narrow Green Belt (<5')**
- **Granite Tree Belt**
- **Permeable Red Brick Tree Belt**
- **Church Street Brick Tree Pits**
- **Sidewalk Cutout**
- **Garden (in ROW)**

The diagram above includes an inventory of the current planting conditions of downtown Burlington's street trees. A detailed description of each of these conditions can be found in *"Street Trees & Tree Belts" on page 24.*

Proposed Tree Belt Conditions

Lawn (behind sidewalk/private property)

Broad Green Belt (>12')

Standard Green Belt (5'-12')

Narrow Green Belt (<5')

Church Street Brick Tree Pits

Permeable Brick Tree Belt (New Type)

** Existing red brick pattern to be used within sidewalk and tree belt areas fronting City Hall on Main and College per Great Streets: Main Street Plan.*

The treebelt pavers should be a matching permeable red brick from the same manufacturer as the one being used for the rest of the treebelt zone.

Tree Belt & Green Belt Typologies

Tree belts can be beautiful, durable, and multi-functional spaces. To make the highest and best use of precious space in the right of way, Burlington will transition many of it's downtown tree belts from concrete or compacted turf to a continuous band of permeable paving. In some residential areas, where pedestrian traffic is lighter and erosion is under control, green belts utilizing turf will remain.

The tree belt buffers pedestrians from traffic and provides a visual amenity for all. In addition to its visual and psychological benefits, this strip between the sidewalk and street provides environmental benefits by absorbing and filtering stormwater runoff, providing shade, reducing the urban heat-island effect, and absorbing carbon dioxide. In Burlington's northern climate, tree belts perform the additional important function of snow storage in winter months.

The width of the tree belt is an important design consideration. At a minimum, tree belts should be six feet wide. Wider belts provide better growing conditions and will result in improved health and vigor of street trees. In general, trees benefit from greater soil volume, a continuous tree belt, or a continuous subsurface soil volume which can be aided by soil cells. In traditional retail areas with on-street parking and higher-intensity pedestrian demands, trees will be planted in prepared beds of structural soil running beneath the sidewalk.

Structural soil is an engineered soil mix that serves the dual function of supporting the pavement and accommodating root growth. This allows a continuous soil volume to be achieved by connecting subsurface planting beds to one another or to nearby landscape areas. In some situations, soil cells utilizing horticultural soil can also be utilized to create the capacity for a tree's root system to grow where the idea tree belt width cannot be achieved.

These healthier growing conditions are easier to achieve in appropriately-sized tree belts. This section provides guidance for the application of the various techniques as illustrated in the *"Proposed Tree Belt Conditions" on page 175*, including:

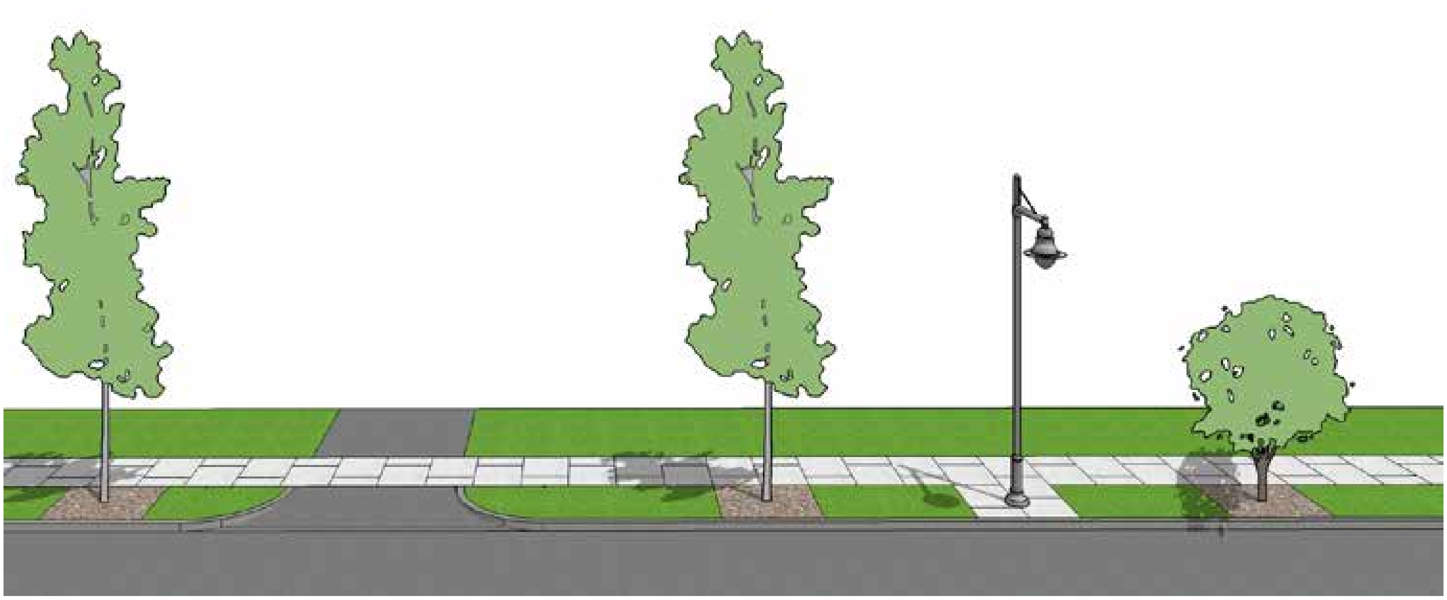
Gray Brick Tree Belt with Permeable Pavers

- 6' Minimum Width, with tree planters or tree grates
- 8' Preffered Width with tree planters or tree grates

Green Belt with Turf

- Lawn (behind the sidewalk/private property)
- Broad Green Belt
- Standard Green Belt
- Narrow Green Belt

For other considerations which affect the placement and treatment of tree belts and green belts, see the *"Element Siting & Considerations" on page 112* for sections regarding Street Trees and Tree Grates and Guards.



BRICK TREE BELT WITH PERMEABLE PAVERS

Description

Permeable Brick Pavers are recommended as the primary surface material for use within the downtown tree belts. Roots and soils are protected from pedestrian traffic by the pavement. Within the newly defined tree belt, street furnishings, café seating, and bicycle parking will sit above a surface that absorbs stormwater and provides uncompacted rooting space for trees below.

Location

- Typically located between the Clear Pedestrian Zone and the Roadway Zone's Parking Lane or Bikeway.
- Continuous across curb-cuts/driveways.
  - At curb-cuts/driveways, impervious pavers of the same color and material and from the same manufacturer as the surrounding tree belt may be used over a concrete base to meet the frequent vehicular loading requirements of these areas.
- Terminates at crosswalk zone before intersection.
- Block corners to be paved with concrete.

Width

6' or 8' depending on conditions and width of Pedestrian Zone in standard cross section. See recommended Street Types on *page 67*.

Materials

Paver specifications: *"Tree Belt Permeable Pavers" on page 277.*

Tree Well Condition

Planted or Tree Grate depending on level of pedestrian activity and width of the Pedestrian Zone. See *page 186* and *page 230* for tree well plantings and *page 307* for tree grate specifications.

Subsurface Conditions

Soil volumes in the tree belt alone may be insufficient to support trees which survive to produce large canopies. Soil cells may be used beneath adjacent pavements to provide required soil volumes to new trees. Structural soils may also be used under sidewalks or where soil cells cannot be used due to limited space or other factors. Horticultural soils are to be used as the medium in soil cells, planted tree wells, and in tree wells covered by tree grates.

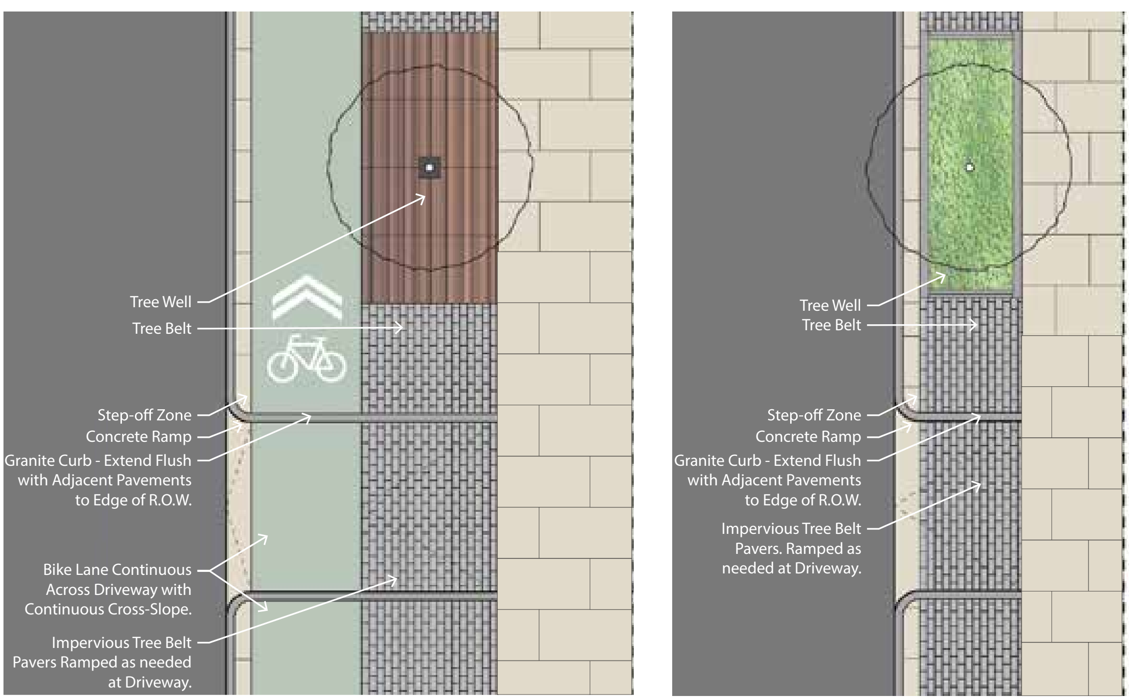
Grading

Grading in the tree belt is used to direct surface stormwater flow. In areas where tree wells are planted and open, the grading of the brick will crease at the center, directing water parallel to the curb and into the tree well. Where tree grates are used, grading will pitch water toward the curb. In all cases, ADA standards for accessibility must be met as a top priority.

Maintenance

Permeable paving allows stormwater to soak into the ground while debris is captured within the system. Paver joints will need to be cleaned quarterly to maintain the pavement system's permeability. The City of Burlington owns and operates equipment for this purpose and will set the schedule for pavement cleaning.

Treebelt at Driveway Entrance



Left: Curb cut at 8' treebelt & protected bike lane

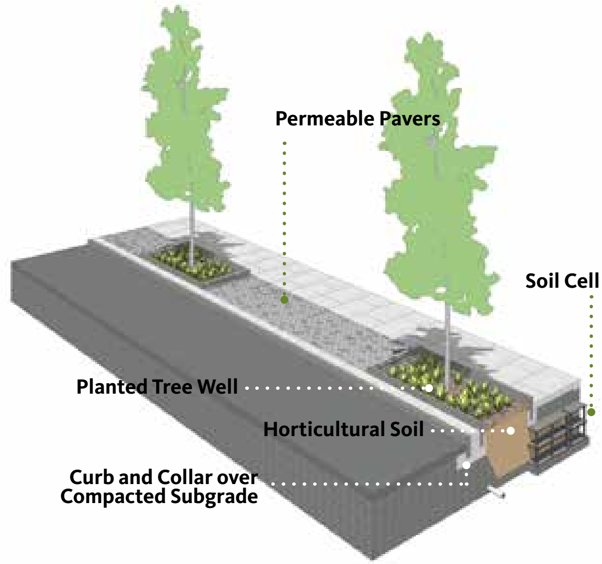
Right: Curb cut at 6' tree belt

6' Wide Brick Tree Belts

Tree Belt with Planted Tree Wells

This is the most common condition anticipated to be applied within the downtown. This should be applied in commercial and mixed use areas with moderate pedestrian activity and where the preferred dimensions for the Pedestrian Zone for cross sections can be met. Trees in this condition are surrounded by salt-resilient plantings in a bed that infiltrates stormwater. Tree wells are typically 12' long, and are framed by 6” wide granite curbs on the sides parallel to the street with metal tree fencing on the perpendicular sides. Small, medium, and large tree species are appropriate in this condition.

See additional tree planting details in *"Tree Planting at Tree Well" on page 185*.

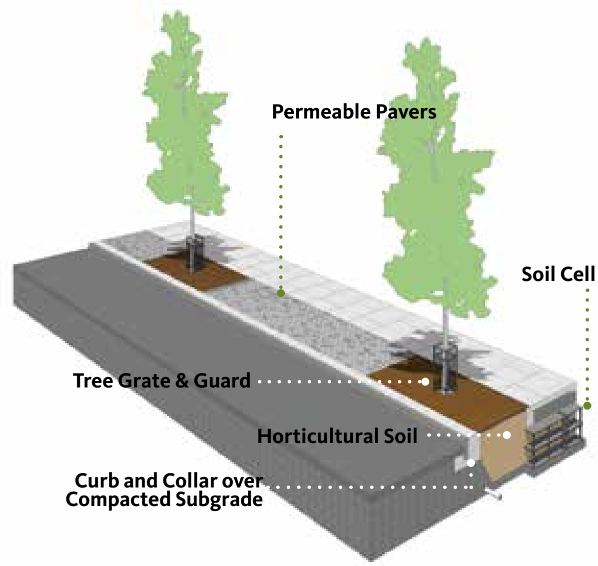


6' wide tree belt utilizing permeable pavers and planted tree wells.

Tree Belt with Tree Grate

This should be applied in commercial and mixed use areas with moderate to high pedestrian activity, frequent restaurant/ retail destinations, and adjacent to loading zones. This may also be used for street types with a preferred Tree Belt/Furnishing Zone dimension of 6', but where the preferred or minimum dimensions for other Pedestrian Zone elements cannot be met due to encroachments or other constraints. Tree roots in this condition are protected by tree grates, and tree trunks by tree guards. Tree grates are typically 12' long, and flush with other pavements. Small, medium, and large tree species are appropriate in this condition.

See additional tree planting details in *"Tree Planting at Tree Grate" on page 184*.



6' wide tree belt utilizing permeable pavers and tree grates and guards.

8' Wide Brick Tree Belts

Tree Belt with Planted Tree Wells

This should be applied in commercial and mixed use areas with moderate pedestrian activity and where the preferred dimensions for the Pedestrian Zone for cross sections can be met. This may be installed adjacent to a Buffer Zone or a Protected Bike Facility at the sidewalk grade, such as the western blocks of Main Street. Trees in this condition are surrounded by salt-resilient plantings in a bed that infiltrates stormwater. Tree wells are typically 16' long, and are framed by 6" wide granite curbs on the sides parallel to the street with metal tree fencing on the perpendicular sides. Only large tree species are appropriate in this condition.

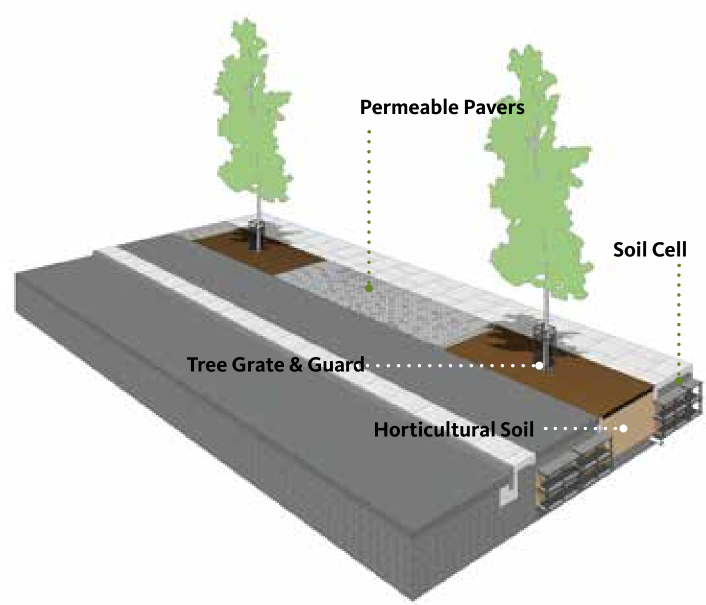
See additional tree planting details in *"Tree Planting at Tree Well" on page 185*.

8' wide tree belt utilizing permeable pavers and planted tree wells.

Tree Belt with Tree Grate

This should be applied in commercial and mixed use areas with moderate to high pedestrian activity, frequent restaurant/ retail destinations, and adjacent to loading zones. This may also be used for street types with a preferred Tree Belt/Furnishing Zone dimension of 8', but where the preferred or minimum dimensions for other Pedestrian Zone elements cannot be met due to encroachments or other constraints. This may be installed adjacent to a Buffer Zone or a Protected Bike Facility at the sidewalk grade, such as the block of Main Street adjacent to City Hall Park. Tree roots in this condition are protected by tree grates, and tree trunks by tree guards. Tree grates are typically 16' long, and flush with other pavements. Only large tree species are appropriate in this condition.

See additional tree planting details in *"Tree Planting at Tree Grate" on page 184*.



8' wide tree belt utilizing permeable pavers and tree grates and guards.

GREEN BELT WITH TURF

Description
Green belts planted with turf are the most common existing tree planting condition within the downtown; as such, many of the busiest streets and widest setback areas in downtown utilize this condition. In some instances, large, open soil volumes exist to support tree growth. If appropriately maintained, trees may survive in this condition to produce large canopies. However, in other locations, the width of the green belt can limit trees' ability to reach a mature size, or levels of pedestrian activity may damage roots and lead to soil compaction. Green belts with uncompacted soils provide some level of stormwater infiltration.

Location
- Typically located between the Clear Pedestrian Zone and the Roadway Zone's Parking Lane or Bikeway.
- Terminates at intersections.

Width
5'–8'+, depending on conditions and width of Pedestrian Zone in standard cross section. See recommended Street Types on *page 67*.

Materials
Standard VTrans Urban Lawn Mix in *Appendix section A-6*

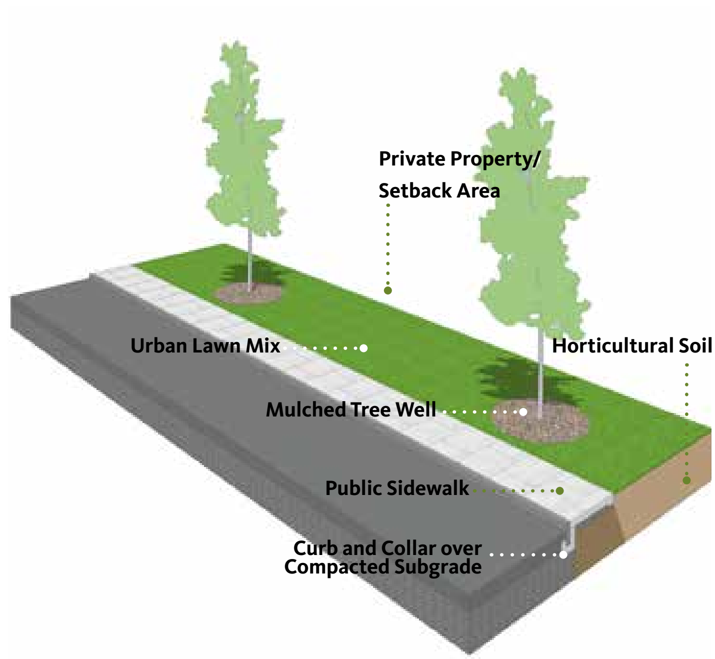
Tree Well Condition
Mulch around roots, turf between plantings. See additional tree planting details in *"Tree Planting in Turf Green belts & Lawns" on page 183*.

Subsurface Conditions
Depending on width of green belt, soil volumes may be sufficient to support trees which survive to produce large canopies. However, for Standard and Narrow Green Belt conditions, the soil volumes in the tree belt alone may be insufficient. Soil cells may be used beneath adjacent pavements to provide required soil volumes to new trees. Structural soils may also be used under sidewalks or where soil cells cannot be used due to limited space or other factors. Horticultural soils are to be used as the medium in soil cells and unpaved portions of the green belt.

Maintenance
These green belt conditions should be monitored. If evidence appears of compaction and erosion due to the level of pedestrian activity, a pavered tree belt solution should be considered to protect tree roots and avoid excessive stormwater runoff and channelization.

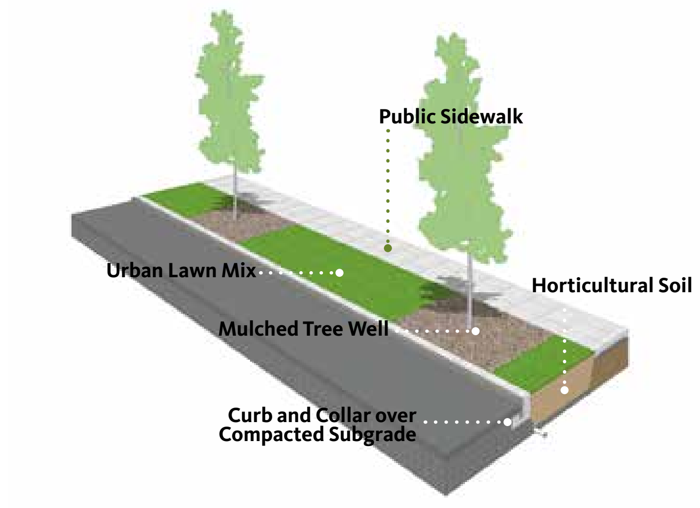
Green Belt Types

Lawn (behind sidewalk/on Private Property)
There are several locations within downtown where trees on private property function as part of the streetscape, and provide the benefits of street trees. As deemed appropriate by the City Arborist, this condition should remain until redevelopment prompts the installation of a standard tree belt. In these conditions, no soil cells or structural soils are necessary as the large, open soil volumes available on the private property or within setbacks are generally sufficient to produce trees with large canopies. New trees can be planted within lawn areas behind the sidewalk when there is no ability to locate trees within the public ROW, or when it is not anticipated that the adjacent property will be redeveloped within the next 20–30 years. Small, medium, and large tree species are suitable for planting in these conditions.



Trees located behind the sidewalk on private property or in setback areas providing benefit of street tree to public ROW.

Broad Green Belt
This condition currently hosts trees planted along some of the busiest streets and widest sidewalk setbacks in Burlington. As deemed appropriate by the City Arborist, this condition may remain in selected areas in order to preserve large, healthy trees. However, this condition is prone to compaction and erosion in areas with adjacent on-street parking and/or high levels of pedestrian activity. This condition should be replaced with the standard tree belt as blocks are redeveloped when trees are in struggling condition or where preservation of the existing green belt is infeasible. Where these green belts are more than 8' wide, large, open soil volumes are often sufficient to support trees which survive to produce large canopies. Soil cells may be used beneath pavements if necessary to provide required soil volumes to new trees. Small, medium, and large tree species are suitable for planting in these conditions.

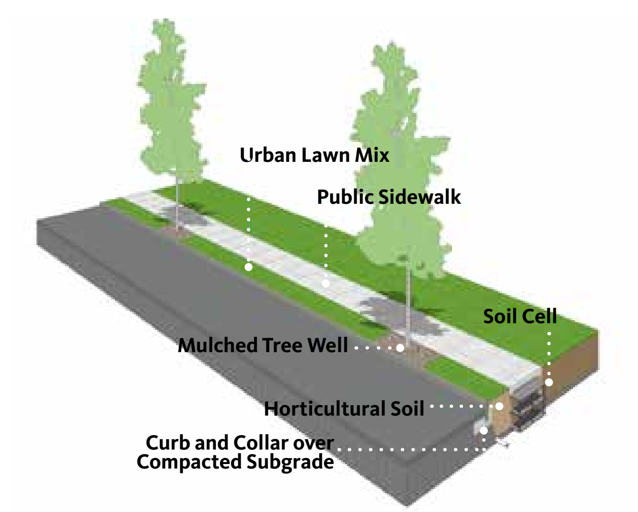


Broad green belt condition with 8'+ of turf between the curb and sidewalk.

Standard Green Belt
This is the historic green belt condition in downtown. However, this condition is only desirable on primarily residential streets with low foot traffic and on blocks with slopes of less than 5%. Therefore, this condition may remain in selected areas as indicated in the Proposed Tree Belt Condition diagram. In order to protect against compaction and erosion that can damage roots and turf, an 18-inch "carriage walk" should be installed along the curb line within the green belt where possible. Soil cells may be utilized beneath pavements if needed to provide required soil volumes for new trees. Otherwise, horticultural soils should be used in unpaved portions of the green belt at a minimum depth of 36". Small, medium, and large tree species are suitable for planting in these conditions.

Standard green belt condition with an 18" "carriage walk" adjacent to the curb to protect tree roots and turf from erosion from adjacent on-street parking.

Narrow Tree Belt
This tree belt type exists where a narrow ROW accommodates only a slender green belt. In the future, this condition is only appropriate on primarily residential streets where there is already a narrow/substandard green belt and with low pedestrian traffic. In this condition, soil volumes in the green belt alone are insufficient to support trees which survive to produce large tree canopies. Soil cells or root trenches shall be used underneath pavement to provide required soil volumes for new trees. A root trench is a 12" wide × 18" deep (min.) trench filled with uncompacted horticultural soil that connects a tree well to nearby soils. Root trenches may pass beneath sidewalks and through retaining walls or other obstacles and must provide unobstructed root access to soils appropriate for supporting healthy tree growth. Only small tree species are appropriate for planting in these conditions.



Narrow green belt condition with soil cells to support small tree species.

Tree Planting Details

TREE INSTALLATION GUIDELINES

This section includes guidelines for the installation of new street trees. The following are general installation guidelines that apply to all tree plantings. Additional details for specific tree belt planting conditions can be found on the following pages.

- Only plant one row of trees per each side of street
- Select from species identified in these standards; ensure a warranty of at least 1 year post installation/substantial project completion/project acceptance
- Coordinate with utility owners to determine whether Soil Cells or Structural Soils are preferred directly over utility lines. Ensure locations of utilities have been identified; call DigSafe 811 to verify.
- Prepare subsurface for tree installation.

Soils

- Place Tree on (85% maximum) compacted Setting Mound made of Horticultural Soil, assuming native soils are not appropriate.
- If suitable soils exist nearby, these may be accessed to provide required soil volumes.
- Provide minimum volume soil for each tree based on Species List provided in this document.
- Soils beneath paved surfaces must be protected from compaction with soil cells.
- Structural soils are permitted in areas where soil cells cannot fit or are otherwise impractical. (Structural soils can only make up a max 20% of total soil volume for each tree.)
- Install Soil Cells and Structural Soil per manufacturer-provided specifications.
- Soil depth minimum is 3' with variations allowable at building/utility conflicts.
- To access nearby soils across impervious subgrades, connect them to the Treebelt using a 2' W × 3' D min. channel of Soil Cells (min. 1 per tree).

Drainage

- Prepare subgrade for drainage as site conditions allow.
- On sites suitable for infiltration, provide Gravel Drainage Layer on subgrade.
- Use Geotextile Fabric to Protect Gravel Drainage Layer from filling with soils.
- Provide perforated Soil Drainage Pipe connected to city stormwater or combined sewer.

Root Barrier

- Provide Root Barriers to direct roots away from adjacent pavements, curbs, underground utilities, and other sensitive underground features.

Irrigation/Aeration

- Provide Irrigation/Aeration System for hand-watering and gas exchange.
- Set inlet at grade. Protect the opening from debris.
- Automatic irrigation systems are permitted, not required.
- Consider using harvested rainwater to supply irrigation systems.

Tree

- Remove all burlap, wire baskets, nails, etc. from the root ball.
- Set tree plumb.
- Set top of root flare at top of soil profile. Do not bury the root flare.

Tree Anchor

- Anchor tree with subgrade tree anchor system with pre-approved products or others approved by the City Arborist.
- Stake trees with less than 3" caliper. Generally, larger trees do not require staking unless they are in a very windy area.

Pollutants

- Roadway runoff is permitted in stormwater planters.
- Roadway runoff is **NOT** permitted in sidewalk tree wells.

Approved Products

These products are pre-approved to meet tree planting requirements in the downtown ROW. Substitute products offering equal performance may be used if approved by the City Arborist.

Root Barrier

- ReRoot Linear Ribbed Root Barrier by GreenBlue Urban
- RootStop by GreenBlue Urban
- Root Barrier by Deeproot
- EP Series Root Barriers by NDS
- Platipus Root Barrier by Platipus

Irrigation/Aeration System Components:

- RootRain ArborVent & RootRain Pipe—by GreenBlue Urban
- RootRain Precinct & RootRain Pipe—by GreenBlue Urban
- RootRain Urban—by GreenBlue Urban (Turf Treebelt Only)
- RootRain Civic—by GreenBlue Urban (Turf Treebelt Only)
- RWS Root Watering System 36" Depth—by Rain Bird

Tree Anchor

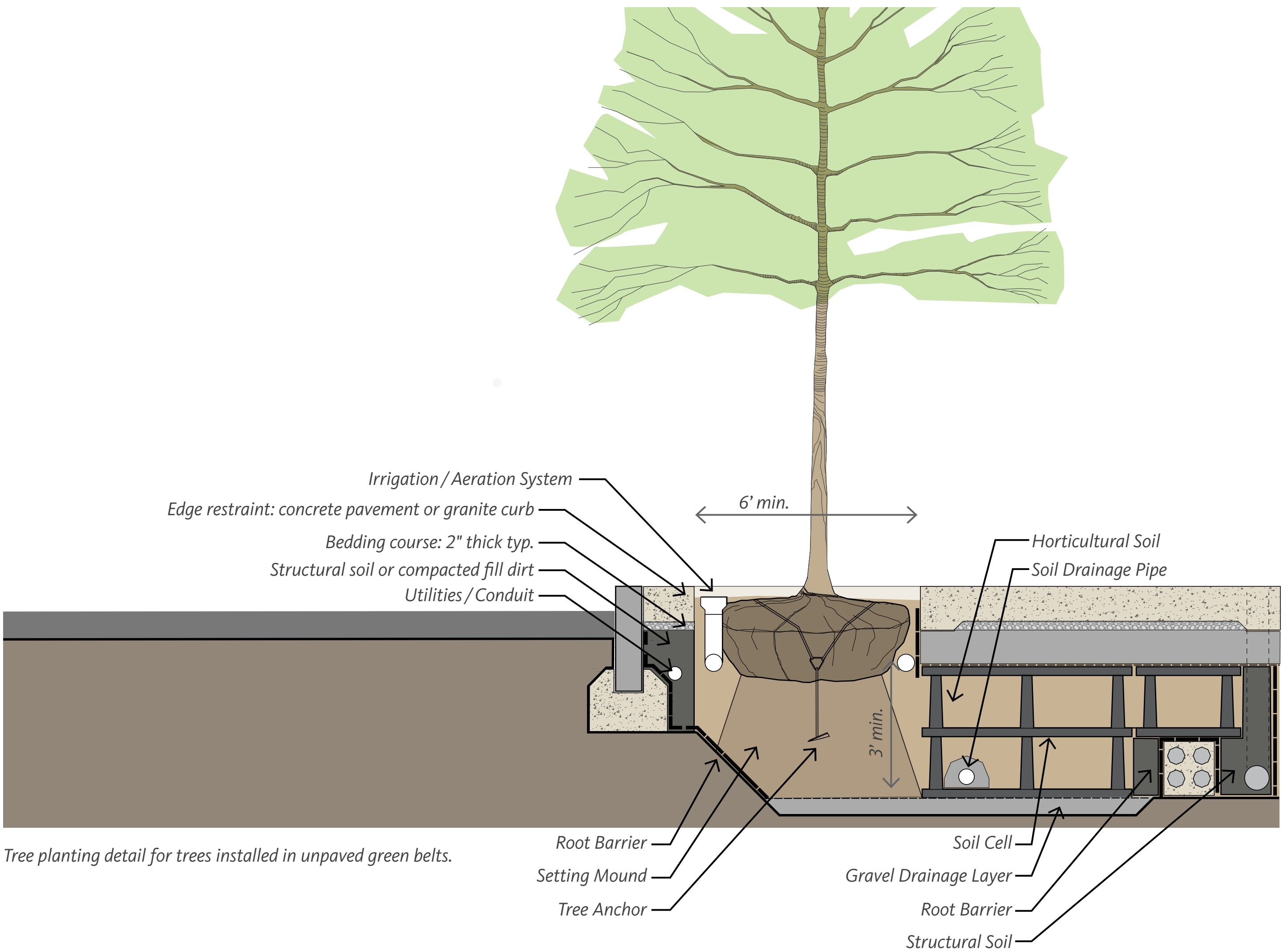
- ArborGuy—by GreenBlue Urban
- Root Ball System—by Duckbill Earth Anchors
- Strap Rootball Fixing System—By Platipus

TREE PLANTING IN TURF GREEN BELTS & LAWNS

Trees planted within green belts shall follow all *"Tree Installation Guidelines" on page 182*, as well as these additional details.

Mulch

- Mulch a square area with the tree in its center at a 2” depth.
- The mulched area must cover the full width of the green belt.
- In Lawn and 8’+ Broad Green Belt areas, mulch a circular area with a 4’ radius centered on the trunk.
- Bare soil should be left at the base of the tree to avoid trunk suffocation or rot.
- Do not sod or seed within the mulch area.
- Weed-prevention fabrics and geotextiles are not permitted.



Tree planting detail for trees installed in unpaved green belts.

TREE PLANTING AT TREE GRATE

Trees planted within green belts shall follow all *"Tree Installation Guidelines" on page 182*, as well as these additional details.

Soils

- Soils are depressed 3" below the adjacent pavement grade, and 4–6" below the underside of the tree grate.

Tree Anchor

- Anchor to tree guard.

Tree Guard

- Install Tree Guards for all trees planted in tree grate condition.
- Adjust guard in accordance with tree growth to avoid metal coming in contact with bark. Remove at the discretion of the City Arborist, when caliper is of sufficient size.

Tree Grate

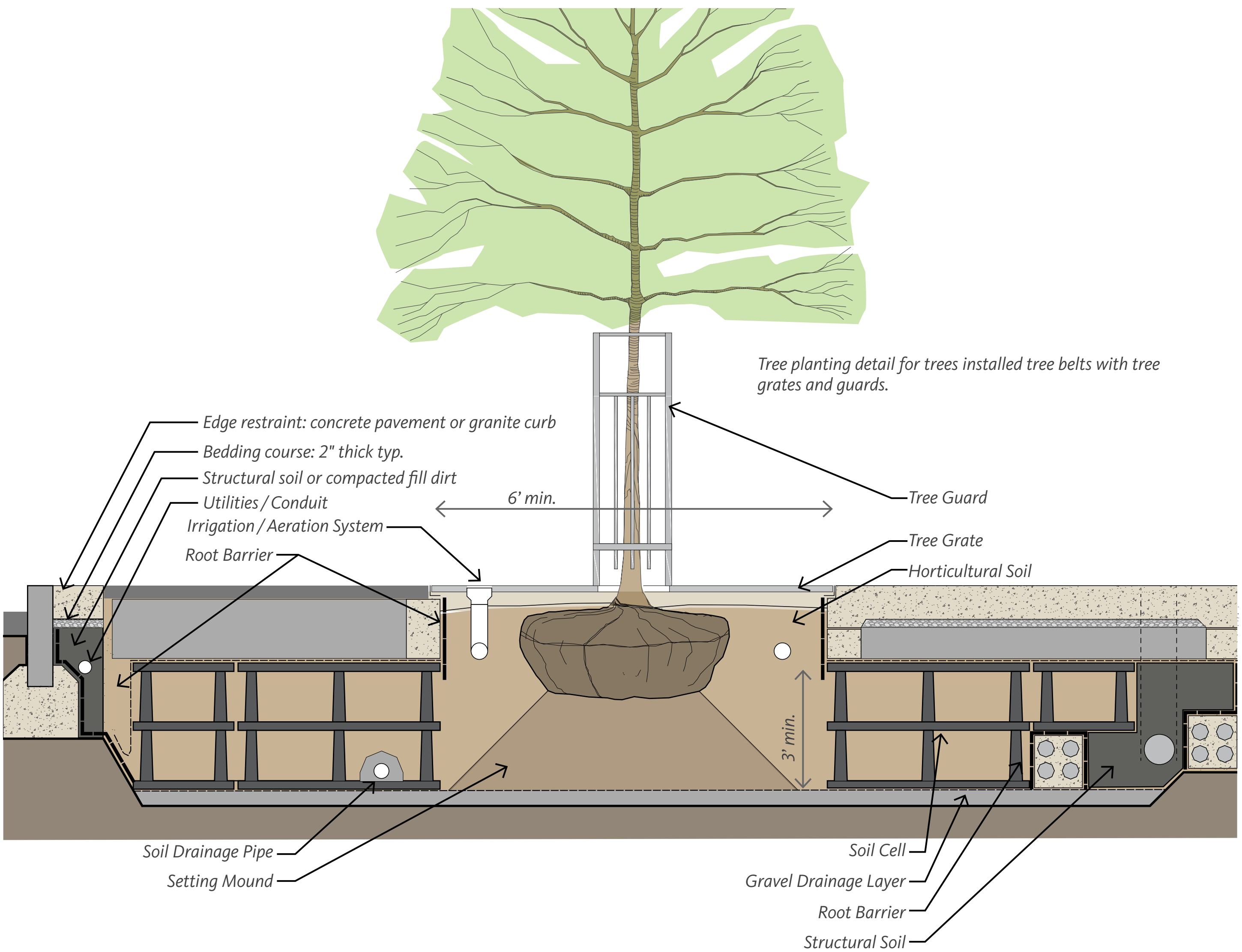
- Tree Grate width must match Tree Belt/Furnishing Zone width.
- Tree grate minimum length is twice the tree grate width. (6' × 12', 8' × 16', etc.)
- Tree grate openings must be expanded over time to accommodate the tree's trunk without scarring it.
- Tree grate shall be level with sidewalk per ADA requirements.

Groundcover

- Option: plant Sedum Blend listed in this document to cover soil surface under grate.

Mulch

- Mulch at a 2" depth to cover entire soil surface under grate.
- Bare soil should be left at the base of the tree to avoid trunk suffocation or rot.
- Weed prevention fabrics and geotextiles are not permitted.



Tree planting detail for trees installed tree belts with tree grates and guards.

TREE PLANTING AT TREE WELL

Trees planted within green belts shall follow all *"Tree Installation Guidelines" on page 182*, as well as these additional details.

Groundcover

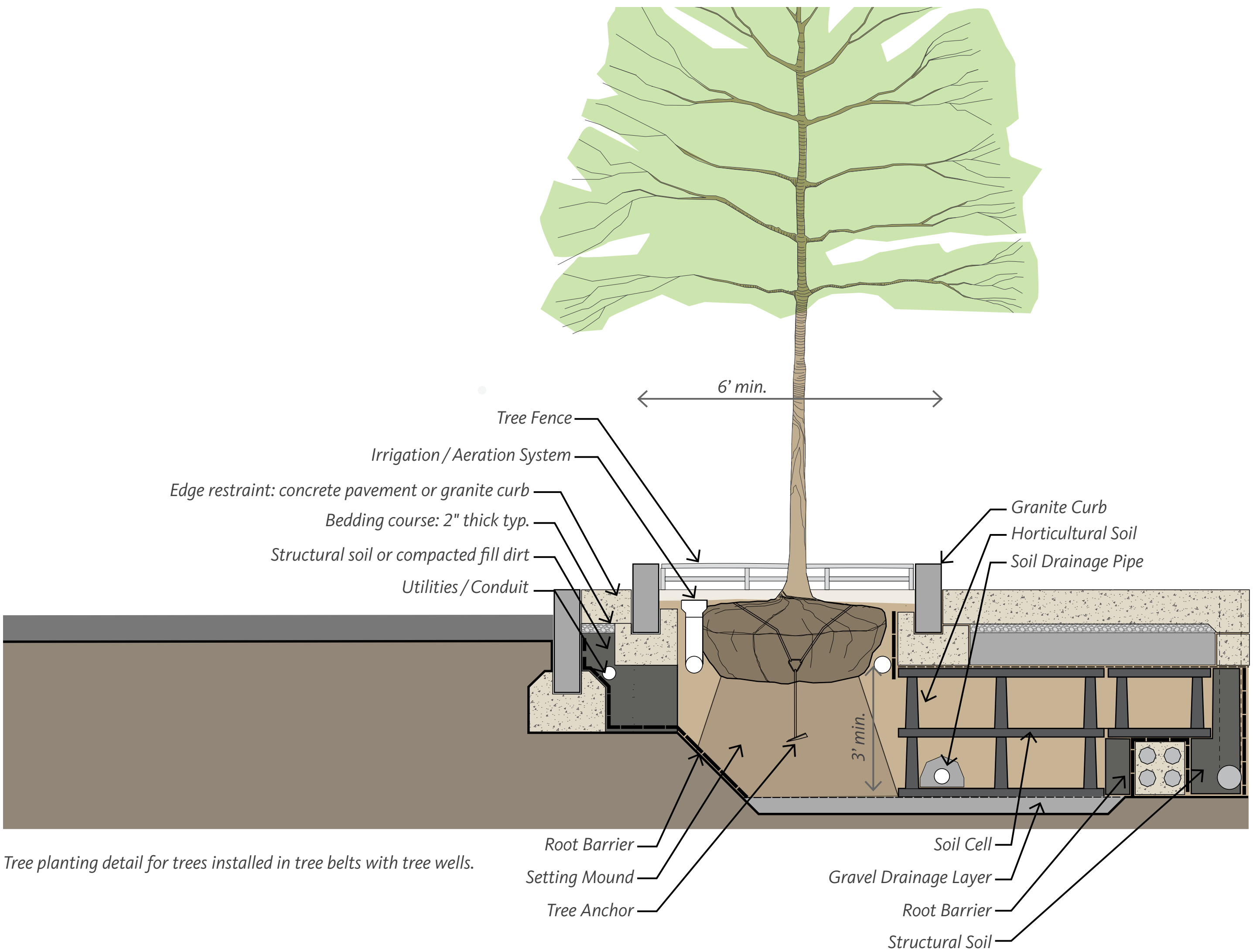
- Plant Groundcover to cover the soils beyond the rootball.
- Select Groundcover species from the recommended list in this document.

Mulch

- Option: Mulch at a 2" depth to cover entire soil surface within tree well.
- Bare soil should be left at the base of the tree to avoid trunk suffocation or rot.
- Weed prevention fabrics and geotextiles are not permitted.

Reference

See *"Tree Well Curb & Fence Details" on page 186*.



Tree planting detail for trees installed in tree belts with tree wells.

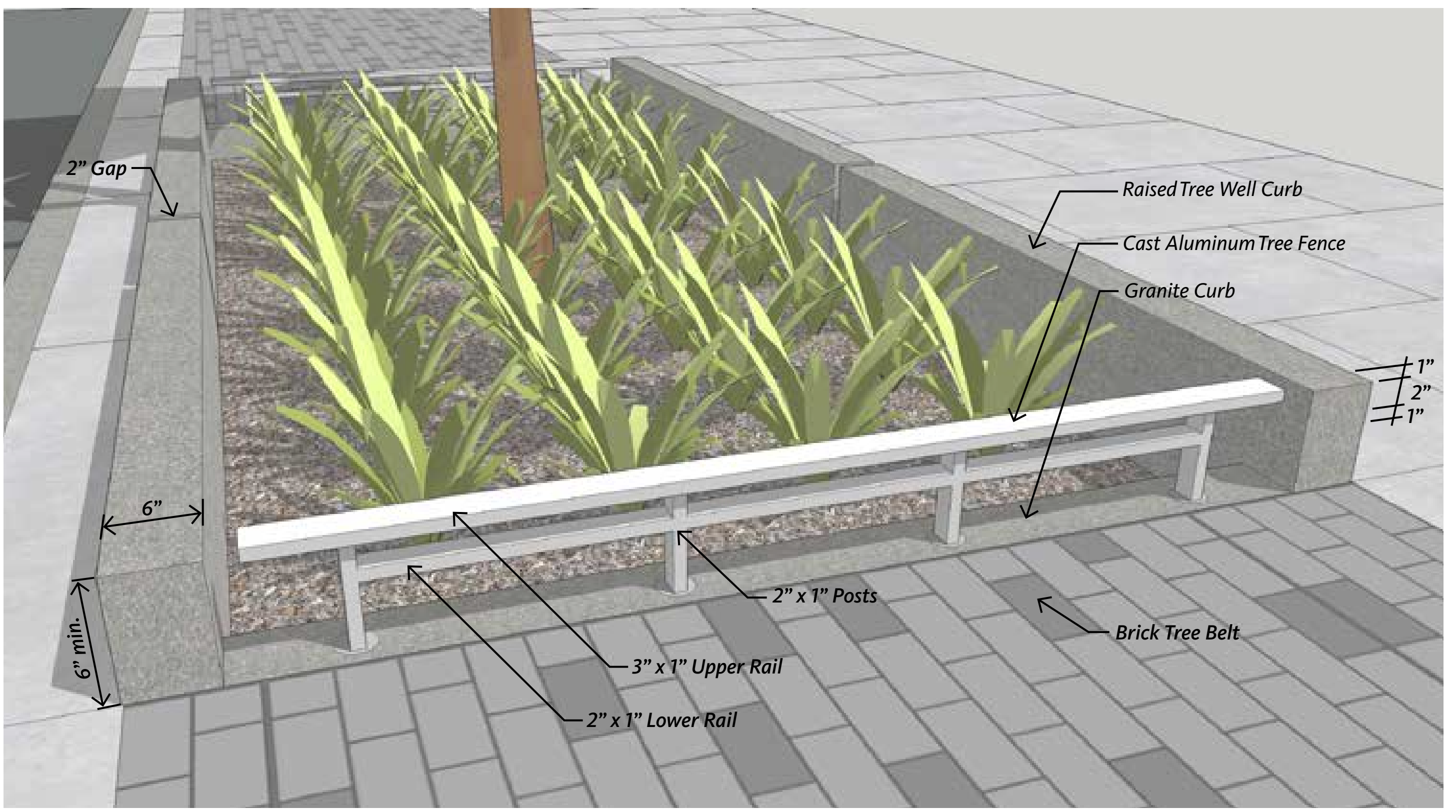
TREE WELL CURB & FENCE DETAILS

Granite Curb

- Granite Curbs shall frame all edges of open tree wells that are within brick tree belts.
- Curbs parallel to the street shall have a minimum 6" reveal above adjacent pavement surfaces. Curbs perpendicular to the street shall be flush with adjacent pavement surfaces to allow stormwater infiltration and overflow. Slope with grade as site conditions allow.
- Granite shall match nearby street curbs as closely as practical in stone source & quality.
- Curbs shall be 6" deep, and have a sawn, thermal finish.
- Curbs shall be set in concrete collars, designed to support them and hold them in place through freeze-thaw cycles and impacts from sidewalk plows/utility vehicles.
- Curb collars shall not be visible. Collars must sit 3” min. below horticultural soil grade in beds. Collars must allow adjacent surface pavements to meet the face of the curb.
- One 2” gap may be cut for every 36” (linear) of raised curb to allow stormwater infiltration from adjacent pavements.

Metal Fence

- Tree Well Fences shall be set into flush portions of the Tree Well Granite Curbs with a weather-resistant non-shrink grout. Posts shall extend into curb a minimum of 6”.
- Fences shall be made of Cast Aluminum, appropriate for outdoor use, with a minimum 50% recycled content.
- Aluminum Fences shall be Hot Dip Galvanized and finished with Gray Aluminum RAL 7007 Powdercoat.
- Aluminum Fence posts shall be 2” × 1”. Aluminum Fence upper rail shall be 3" W × 1" H, and lower rail shall be 2” W × 1”H.
- Align posts with center line of supporting curb. Center rails on posts. Rails shall match the slope of their supporting curbs.
- The upper rail shall be flush with adjacent raised granite curbs on both ends. The lower rail shall be set 3” o.c. below the top rail.
- Weld all post/rail connections & grind smooth.
- Treat metals to minimize corrosion where they are in contact with grout.



Detail for granite curbs and metal fencing to be installed around planted tree wells in brick tree belts.

PERMEABLE PAVER INSTALLATION

Design & Performance

- Permeable pavement systems are complex and must be designed by a licensed landscape architect or civil engineer on a site-specific basis.
- The diagram provided below is conceptual only and is not intended for use as a construction document.
- Refer to manufacturers for installation and maintenance requirements of all products. Modifications to typical details may be necessary based on site conditions.
- All permeable pavements in the ROW must support AASHTO H-20 loading.
- Where permeable pavers are installed over soil cells or structural soils, coordinate the design of these systems in consultation with their respective manufacturers.
- Permeable paver systems must provide ADA accessibility.
- In constrained sidewalk conditions when a tree belt is located directly adjacent to the curb—no 12-inch step-off zone—a 2-paver deep soldier pattern should be used to frame the running bond between the curb and the parallel pavers (see Figure 4 on page 188).

Subgrade

- Typically, permeable paver subgrade should be designed to allow stormwater infiltration into the soils below. No geotextile should be used to maximize the long-term effectiveness of the system. If geotextile is deterimined to be necessary, the product must be non-woven.
- On some infiltration this may be inappropriate due to soil type, subsoil/geologic conditions, or conflicts with underground structures, etc. On sites where infiltration is inappropriate use an impermeable liner to prevent infiltration.
- Where impermeable liners are used beneath permeable pavers, drainage pipes must be provided to drain all storm water into the storm sewer system. Coordinate subsoil drainage design and storm sewer connection with Burlington Department of Public Works.

Aggregates

- Do not use sand, stone dust, or stone screenings within the paving system.
- Filler stone must be #8 stone, and must either be from a manufacturer who distributes stone for this express purpose, or must be thoroughly washed and show a sieve analysis of no more than 1% passing a No. 200 sieve.

Base & Sub-base

- Sub-base may rest directly on subgrade or on Soil Cells/ Structural Soils.
- Sub-base depth will vary based on expected loads.
- Where Sub-base rests directly on Soil Cells/Structural Soils, a geotextile layer will be necessary to maintain separation between the Sub-base and and the soils below.
- Compact Base & Sub-base materials in minimum 6” lifts.
- Geogrid Fabric may be required for additional reinforcement and ground stabilization.

Paver Joints & Bedding Course

- Use only washed aggregates without fines in Paver Joints & Bedding Course.

Permeable Pavers

- Consider paver durability and safety when selecting which standard pavers are appropriate to use in the ROW.

Edge Restraint

- Permeable Pavers in the downtown ROW shall be contained by concrete pavement or granite curbs on all sides

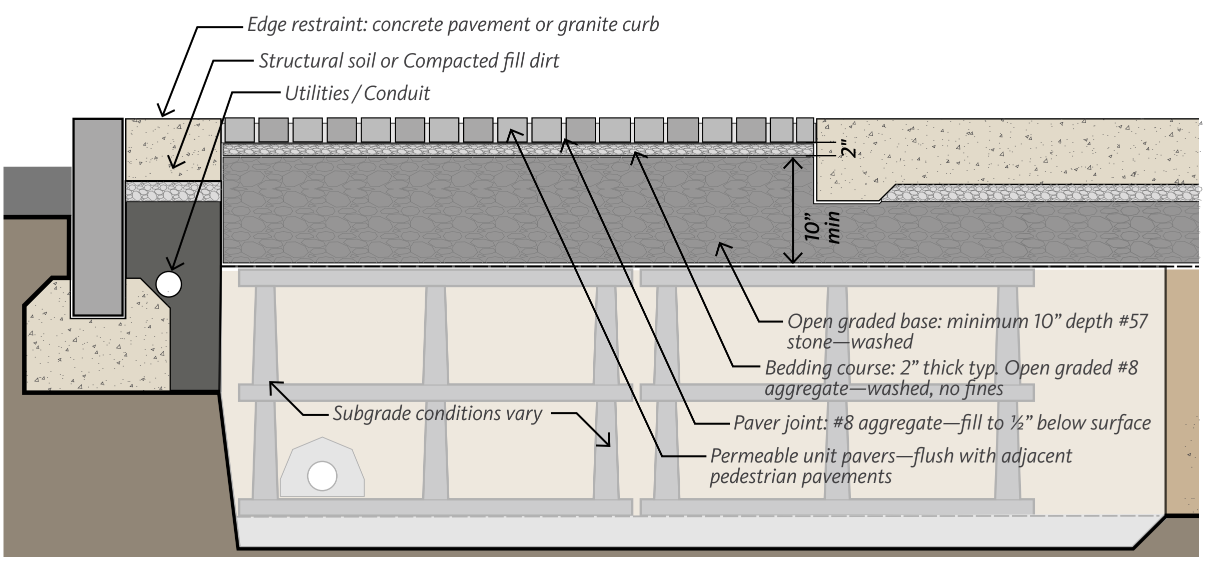


Figure 3: *Standard Tree Belt with 12" step-off zone*

Standard Tree Belt configuration is composed of 6' or 8' wide paver band with a 12" concrete step-off zone adjacent to granite curb. Where possible, it is encouraged that utilities be accomodated under step-off zone.

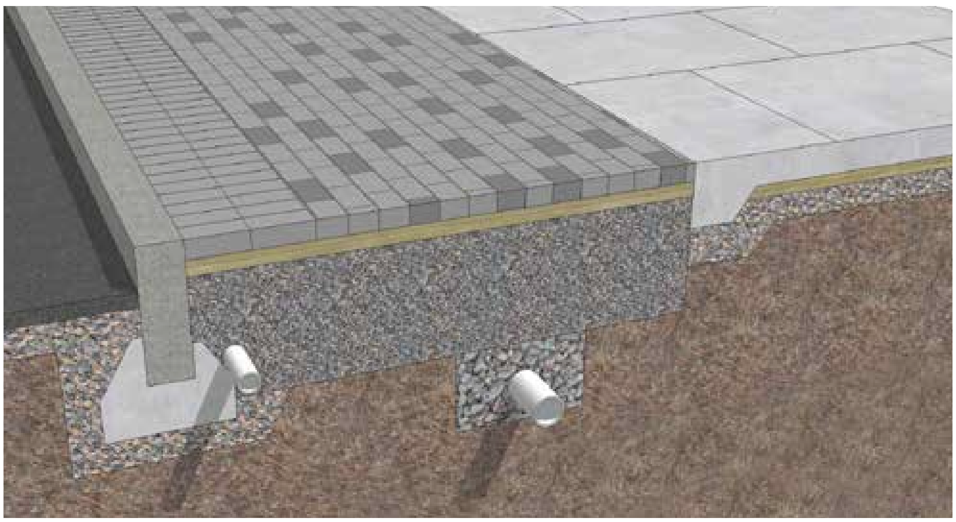


Figure 4: *Tree Belt adjacent to curb without 12" step-off zone*

In constrained sidewalk conditions when a tree belt is located directly adjacent to the curb—without a 12-inch step-off zone, as illustrated in Figure 3—a 2-paver deep soldier pattern should be used to frame the running bond between the curb and the parallel pavers.

Figure 5: *Tree Belt adjacent to curb with Soil Cell condition near tree well with tree grate*

When soil cells are needed to achieve required planting soil volume, soil cells should be held back 12" from back of curb to allow for utilities. Structural soil or compacted fill dirt should be used in this 12" band.

Tree Protection

Tree Protection Zone (TPZ)

- Trees within the ROW may not be removed without the consent of the City Arborist and are to be protected from injury or damage during construction.
- Designate trees to be protected from construction impacts in cooperation with the City Arborist.
- Establish a tree protection zone to protect trees within 25’ of construction/demolition work (including utility digging and trenching).
- In open lawn areas and beds, TPZs shall have a minimum 1’ radius, centered on the protected tree, for every 1” of trunk DBH.
- In Treebelts, extend the TPZ in each direction at a minimum length of 1’ for every 1” of DBH at the full width of the treebelt or until an impermeable paved surface is reached.
- Where extreme site constraints or obstacles restrict the TPZ to a smaller area: Determine whether the tree is a good candidate for preservation with the city arborist. Trees with damage to over <30% of their root systems may be severely compromised. Where site workers must enter a TPZ, protect the soil with a 6” thick layer of shredded bark or wood chip mulch for the duration of the disturbance period.
- Within the TPZ, Vehicular Traffic is strictly prohibited.
- Within the TPZ, storage of tools , equipment, soil, or construction materials is strictly prohibited.

Pavement Removal

- Where existing pavement is to be removed within the root zone of a protected tree, leave pavement in place as long as possible.
- Review removal technique with project arborist or project landscape architect.
- Once pavement has been removed within the root zone of a protected tree, vehicular traffic over the roots is prohibited without consultation with and consent from the City Arborist.

Tree Protection Fence

- Install a Tree Protection Fence at the boundary of each TPZ.
- Install Tree Protection Fence before construction/demolition work (including utility digging and trenching).
- The top of the Tree Protection Fence shall be 6’ above the surrounding grade.
- Tree Protection Fence shall be VTrans Standard F-2 Chain Link Fence (Type 1)
- Avoid disturbing tree roots with posts.
- Set Posts a minimum of 36” into existing grade.
- Where Tree Protection Fence is installed within the root zones of existing trees, posts shall not be set in concrete.
- Tree Protection Fence shall not be removed until the completion of all construction activity.

Root Pruning & Trenching

- Where roots are encountered at the TPZ boundary, root pruning, or the decision to expand the TPZ, shall occur under the direction of a project’s licensed landscape architect, an ISA certified arborist, or the City Arborist.
- Where new utility trenches must pass through the TPZ, utilize air-trenching or horizontal boring to avoid tree root disturbance. Mechanical digging/trenching is prohibited without approval of the City Arborist.
- No roots larger than two inches (2”) shall be cut unless no other alternative is feasible and upon the approval of the City Arborist.

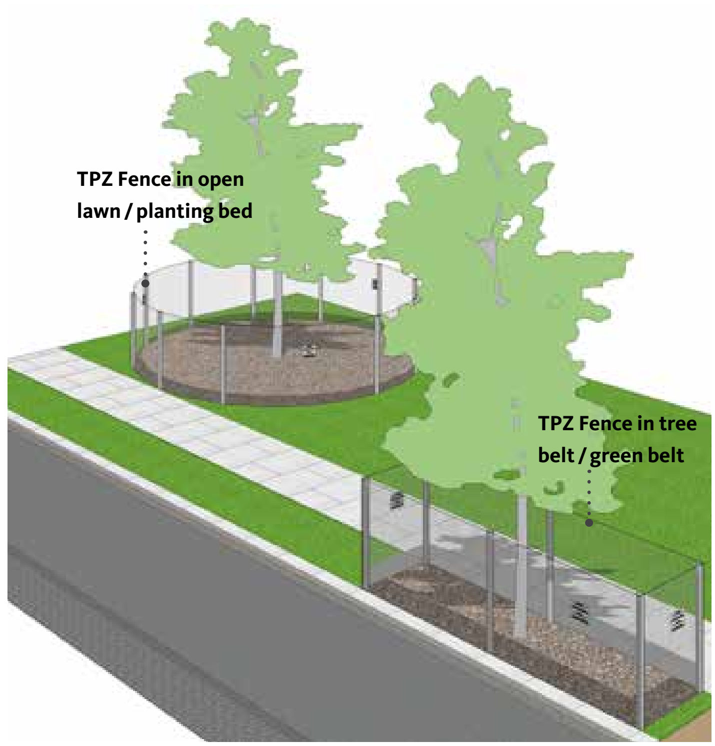
Mulch

- Apply a mulch at a loose depth of 3” to cover the entire TPZ.
- Mulch shall be made of wood chips, or triple-shredded pine or hardwood bark. It must be free from deleterious materials, suitable as a top-dressing in planted areas, and brown in color.
- Bare soil should be left at the base of the tree to avoid trunk suffocation or rot.

Tree Protection Sign

- Install Tree Protection Signs at 25’ intervals along all Tree Protection Fences. (min. 1 sign per TPZ)
- Signs shall be white, 10” × 12” and made of a durable & weatherproof material.
- Sign text shall be black with a minimum letter height of ½”.
- Required sign text:

NO ENTRY—TREE PROTECTION ZONE.
DO NOT PLACE MATERIALS
OR EQUIPMENT IN THIS AREA



Soil & Subsurface

Proper soil selection and management is one of the best ways to support healthy vegetation and to improve stormwater management in urban areas. Healthy soils—soils that have a high organic content and plenty of pore space—support healthier trees and plants and promote more groundwater recharge and better filtration of stormwater. Heavily compacted soils act almost like pavement, absorbing little water and supporting less biological activity than well aerated soils.

Soils within tree belts and planted areas that have become compacted and degraded can be significantly improved with aeration and/or the addition of soil amendments, such as weed-free compost, to help retain soil moisture. Soil improvements can make a significant difference in the health and longevity of trees and other vegetation can also improve stormwater management. Soil maintenance should be part of an operation and maintenance plan for urban vegetation.

New street trees and plantings present an opportunity to use engineered soils to grow a much larger and healthier greenscape and to clean and recharge significant volumes of stormwater runoff. Design details for planting street trees and implementing vegetated stormwater management techniques are found throughout the Street Ecology chapter. In all of these applications, careful selection of soil type and providing maximum soil volume should be priorities.

In constrained situations where existing street trees cause sidewalk heaving or where space is limited, consider using structural soils. Structural soils are a type of engineered soil that is designed to meet the load bearing requirements of urban streets while still maintaining adequate porosity and organic content to support healthy vegetation. Some structural soils also contain materials that specifically retain moisture. In urban contexts, structural soils allow the placement of ample, healthy soil beds beneath sidewalks and parking areas. Soil cells or root trenches shall be used underneath pavement to provide required soil volumes for new trees. Root trenches may pass beneath sidewalks and through retaining walls or other obstacles and must provide unobstructed root access to soils appropriate for supporting healthy tree growth. Trees and plantings can be grown in dense urban settings with paved surfaces above the root systems, provided there is a way for water to enter the structural soil mixture.

Structural soils require irrigation (passive or active) to support a variety of plant types. Overflow drains may be necessary depending on the characteristics of the surrounding soils. Structural soil applications can both provide a healthier environment for plants and better capture, filter, and recharge of stormwater.

SOIL VOLUME

- Canopy—1000 cu. ft./tree* (1500 cu. ft./tree preferred)
- Medium—1000 cu. ft./tree
- Small—600 cu. ft./tree

Adequate subsoil is essential for healthy tree growth, especially on urban streets. The ability of a tree to grow beyond a certain size is directly related to the volume of soil available for roots. Providing sufficient rooting soil in a dense, urban environment can be costly, but is worthwhile given the unique benefits that mature shade trees provide.

Tree roots do not thrive in highly compacted soil because it lacks the void spaces needed to provide air and water. Roots in compacted soil will migrate toward the surface seeking air and water, potentially cracking and heaving nearby sidewalks.

When the rooting space is inadequate, the tree roots will grow to capacity, and then the tree will decline and die.

Trees in the Northeast U.S. need approximately 2 cubic feet of soil per square foot of canopy area. For example, a tree growing in a 3’ by 8’ by 4’ pit would be expected to reach about an 8’ diameter canopy before becoming stressed and showing signs of decline. If the tree has access to soil outside the pit, the canopy can grow much larger.

*To grow a Canopy Tree to mature size in an urban environment, an uncompacted soil volume greater than 1,000 cu. ft. is needed. According to research by Dr. E. Thomas Smiley and James Urban, FASLA, the largest potential canopy that can be expected to grow with 1,000 cu. ft. of soil is 800 sq. ft. in spread (roughly 28’ × 28’). In locations where larger mature trees are desired, 1,500 cu. ft./tree of uncompacted soils are recommended.

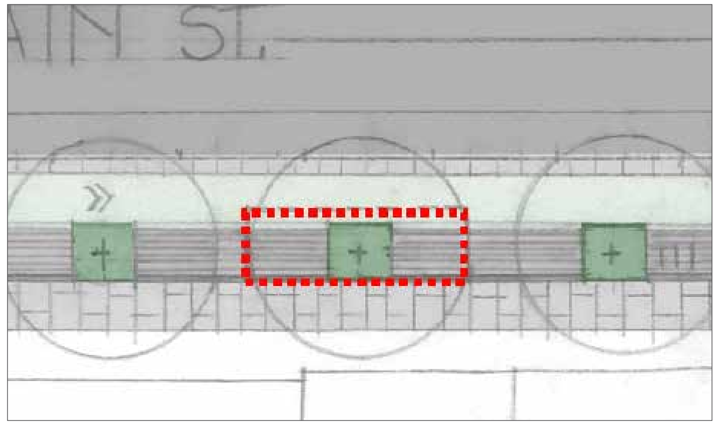
HORTICULTURAL SOIL

Intent: To provide trees, turf, and groundcover plantings with a soil that allows them to thrive and to live out their longest possible healthy life in urban conditions.

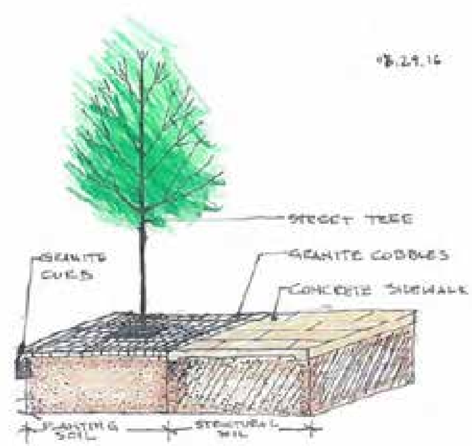
Location: Horticultural soils will fill the entire area of the tree well at a 3’ minimum depth. These soils will also be used in soil cells and will provide the top 18” of the soil profile in turf Treebelts. Horticultural Soil is not intended for use in Bio-retention Plantings.

Design: Consult a soils scientist or a licensed landscape architect, horticulturist, or arborist when designing Horticultural Soils to meet site and plant specific needs.

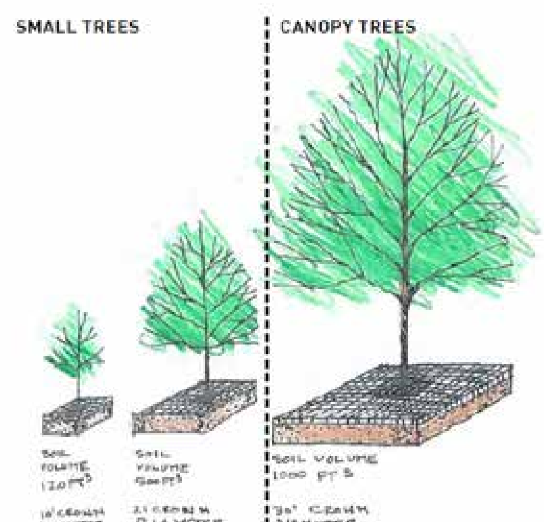
Materials: Horticultural Soil is a fertile, friable, loamy topsoil mix suitable for the support of vegetative growth.



BURLINGTON TREE CANOPY - SOIL VOLUME



One detail that could provide sufficient soil volume and permeability for trees to thrive, a permeable granite cobble band in the tree-belt. This would have the added benefit of being erosion resistant and resilient against snow removal impacts.



Soil volume has a direct impact on a treeís potential to develop into a mature size. Though each species has a specific requirement, a good rule of thumb is that 1000 cubic feet of soil volume should be allocated per tree.

Horticultural Soil Components: Topsoil, Organics, Coarse Sand, Fertilizer, and Biological Amendments

- Topsoil: Unscreened Imported Topsoil or Existing Site Soil
  - Soil Texture: USDA loam, sandy clay loam, or sandy loam.
  - Soil Structure: Retain Peds of min 2" in size prior to mixing.
  - Organic Matter & Soil Chemistry: Suitable for growing the plants specified at the designed location
  - Soil Objects: <5% of total topsoil volume: Clumps of Clay; Debris; Refuse; Roots; Stones; Sticks; Brush; or other litter. Remove all soil objects >8" in their longest dimension.
  - Contaminants. The soil should have no herbicides, heavy metals, biological toxins, or hydrocarbons that will impact plant growth or are at levels exceeding the EPA's standards for soil contaminants.
  - Source: Unscreened Imported Topsoil must be harvested within 50 miles of Burlington, Vermont. Unscreened Imported Topsoil may not contain soils from sources defined by the United States Natural Resources Conservation Service as prime farmland, unique farmland, or farmland of statewide or local importance.
- Organics: Compost shall be commercially prepared Pine Fines or an equivalent compost and must meet US Compost Council STA/TMECC criteria for "Compost as a Landscape Backfill Mix Component" and must not be derived from human waste or animal waste sources.
- Coarse Sand: Clean, washed, natural sand, free of toxic materials, limestone, salt, shale, and slate particles. Must meet ASTM-C33 Standards.
- Fertilizer: If noted by soil test recommendations, add slow-release, organic fertilizer based on soil test and plant requirements.
- Biological Amendments: Amendments such as Mycorrhizal additives, compost tea or other products intended to change the soil biology, as required based on Soil Foodweb Analysis by a qualified soil testing lab.

Horticultural Soil Mix Requirements: Blend Topsoil, Organics, Coarse Sand, Fertilizer & Biological Amendments to make a new soil that meets the Project goals for the indicated planting area.

- Clay content: 15–25% by weight
- Organic matter: 5–10% by weight
- Coarse Sand: 30–65% by weight
- Silt: 15–25% by weight
- Gravel content shall not exceed 10% by weight
- Soluble Salt: < 2 dS/m
- Cation Exchange Capacity: 7–15
- Water Permeability: 1–2 inches per hour when compacted to 85% of maximum dry density
- pH: 6.0–6.5
- At the time of soil installation, add fertilizer or biological amendments, if required, to the planting soil mix at rates recommended by soil testing results for the plants to be grown.

Depth: 3–4' (18" in turf-only areas of tree-belts where tree rooting volume is not required).

SOIL CELLS

Intent: Soil Cells provide most the required soil volume for each tree downtown. These systems protect tree rooting soil from compaction while allowing pavement, vehicular access, and other streetscape uses above.

Location: The primary location for these systems will be beneath permeable pavement in the Treebelt. These systems may also extend beneath the Concrete Sidewalk, Paved Bike Lanes, and in the Step-off zone. In residential areas, the tree-belt is planted in turf. See Figure 5 on page 188.

Systems: Three systems are approved:
- Silva Cells: manufactured by DeepRoot
- StrataVault: manufactured by GreenBlue Urban
- StrataCell: manufactured by GreenBlue Urban

Loading: Soil Cells must be designed to accommodate H-20 loading for all pavements that they support.

Soil Type: Install Horticultural Soils in Soil Cells. Horticultural Soil Mix Requirements may be modified to meet manufacturer's specifications.

Installation: Per Manufacturer specification to accommodate paving and streetscape furnishings above as well as tree grate or curb/fence.

Note: In situations where fewer than 10 soil cells are required to meet minimum soil volume requirements, designers/owners may coordinate with Burlington DPW and Parks Department to determine the best means of achieving adequate soil volume for the site.

CU-STRUCTURAL SOIL™

Intent: CU Structural Soil is a less-costly, but less-efficient method of providing rooting space for street trees beneath pavements as compared to Soil Cell systems.

Materials: CU Structural Soil is a patented mixture of crushed stone, clay loam and Hydrogel developed by Cornell University. (Patent #5,849,069)

Installation: Install per "CU-Structural Soil® A Comprehensive Guide" as published by Cornell University: *http://www.hort.cornell.edu/uhi/outreach/pdfs/CU-Structural%20Soil%20-%20A%20Comprehensive%20Guide.pdf*

Efficiency: The Smiley-Bartlett Field Study suggests that a cubic foot of CU Structural Soil is capable of supporting 20% as much mature tree canopy volume as uncompacted Horticultural Soil.

Use: In areas where soil cells cannot be used because of utilities or other underground impediments, CU Structural Soil may be used to provide no more than 20% of the required soil volume for each tree. CU Structural Soil may also be used to provide root paths beneath paved areas. Root paths provide access to nearby soils suitable for supporting tree growth that would otherwise be made inaccessible by compacted subsoils beneath paved areas.

Source: CU-Structural Soil has been patented and licensed to qualified producers to ensure quality control; its trademarked names are CU-Structural Soil® or CU-Soil®. Obtain CU-Structural Soils an Amereq-licensed company. This assures that the material has been produced and tested to meet research-based specifications.

DRAINAGE & ROOT AERATION

Intent: To prevent subgrade moisture oversaturation and provide subsurface aeration in areas of tree planting.

Material: Linear perforated subsoil drains which connect to the city's storm/combined sewer system.

Operability: Valves that can cut off drainage to the city sewer systems must be installed at each connection to the sewer system. Valves will be installed in the "off" position. Alternatively, drains may be installed without valves, at a higher elevation in the soil profile as agreed upon with the Burlington Water Resources Department. This overflow system will drain automatically when saturation reaches a designed level.

PVC Check-Wells must be installed to monitor subgrade moisture at each street tree.

Location: Underdrainage must be installed beneath all new street trees, regardless of the pre-construction infiltration rate of site soils. Drains must be installed in tree-belts beneath permeable pavements, tree wells, turf Treebelts, Soil Cells, and Sand Based Structural Soils.

Performance: Underdrains must allow saturated soils to drain by gravity to a moisture level that can support the growth of street trees.

SUBGRADE

On sites where water infiltration is appropriate beneath planting soils: Prior to installing planting soil, loosen grade below the installed planting sol to a depth of 18 inches below the sub grade elevation in areas that are compacted and do not easily drain.

Locate and avoid disturbing any existing utility lines or other subgrade structures.

Percolation tests shall be performed to confirm minimum percolation rates of 1–2 inches per hour.

On sites where water infiltration is inappropriate, provide impermeable liners and drainage pipes to drain all subsoil water into the sewer system while maintaining adequate moisture levels to support healthy plants.

Tree & Plant Species

PRINCIPLES

The selection of appropriate trees for the Burlington Streetscape is critical to growing a healthy mature canopy for the city and to meeting the City's goal of 50% urban canopy coverage by 2025.

Trees planted close to the roadway should be of a deciduous salt resistant species. Such trees do not create heavy winter shading that allows the roadway to freeze sooner and thaw later. Even large deciduous trees can have some effect on freeze and thaw cycle.

The approved tree list includes species selected for their cold-hardiness, salt tolerance, and their ability to thrive in an urban environment. The list is divided into three categories as defined by Burlington city code. They should be distributed within the downtown as follows:

Canopy Trees (mature height >50')
- All Commercial Streets

Medium Trees (mature height 25'–50')
- Commercial Slow Streets; Minimum & Major Commercial Streets; Residential Streets
- **Not** on Special Commercial Streets

Small Trees (mature height <25')
- Residential Streets
- On Commercial Streets—Beneath Power Lines or where extreme subsurface conditions prevent adequate soil volumes to support Canopy or Medium trees.

INITIAL SIZE & QUALITY

Street trees should be installed at 2.5"–3.5" caliper unless otherwise requested by the city. To maintain visibility and accommodate pedestrian flow, new trees may be limbed-up ⅓ of their total height, but not more than 8 feet above the adjacent sidewalk. All trees must be of good quality and in compliance with the most recent edition of ANSI Z60.1—American Standard for Nursery Stock published by AmericanHort. Street tree planting must be in compliance with Burlington Municipal Code. All trees must have a single trunk. No multi-stem trees may be planted in the Downtown Burlington Right of Way.

PLANTING CONDITION

TREE TYPE	Planted Tree Well	Tree Well w/ Tree Grate	Broad/Standard Green Belt	Narrow Green Belt	Bioretention (see tree list for appropriate species)
Canopy Tree	●	●	●		●
Medium Tree	●	●	●		●
Small Tree	●	●	● (only beneath power lines)	●	●

TREE SPECIES UNDER CONSIDERATION

The following list of recommended street trees was developed using the Vermont Tree Selection Guide. Additional reference materials include: The Cornell Recommended Urban Trees Guide, Michael Dirr's Manual of Woody Landscape Plants, The Missouri Botanical Garden Plant Finder, and street tree guidelines for Chicago, IL; Toronto, ON; Markham, ON; and Portland, ME.

Note: an asterisk (*) next to a species indicates that it is appropriate for bioretention/rain garden use.

Trees

Canopy Trees (mature height >50')

- *Acer × fremanii* 'Armstrong'—Armstrong Freeman Maple
- *Acer × fremanii* 'Celzam'—Celebration Freeman Maple
- *Acer × fremanii* 'Marmo'—Marmo Freeman Maple
- *Acer × fremanii* 'Sienna'—Sienna Freeman Maple
- *Acer rubrum sp.*—Red Maple *
- *Cercidiphyllum japonicum sp.*—Katsuratree
- *Celtis occidentalis sp.* —Hackberry
- *Celtis occidentalis* 'Chicagoland'—Chicagoland Hackberry
- *Celtis occidentalis* 'Prairie Pride'—Prairie Pride Hackberry
- *Ginkgo biloba* 'Autumn Gold'—Ginkgo
- *Ginkgo biloba* 'Magyar'—Ginkgo
- *Ginkgo biloba* 'Princeton Sentry'—Ginkgo
- *Gymnocladus dioicus sp.*—Kentucky Coffeetree
- *Platanus × acerifolia* 'Morton Circle'—Exclamation! London Planetree *
- *Quercus bicolor sp.*—Swamp White Oak *
- *Quercus imbricaria sp.*—Shingle Oak
- *Quercus rubra sp.*—Red Oak
- *Taxodium distichium sp.*—Baldcypress *
- *Tilia Tomentosa sp.*—Linden
- *Ulmus americana* 'Princeton'—Princeton American Elm *
- *Ulmus minor* 'Triumph'—Triumph Elm *
- *Ulmus ×* 'Morton'—Accolade Elm *
- *Ulmus ×* 'Morton Glossy'—Triumph Elm *
- *Ulmus wilsoniana* 'Patriot'—Patriot Elm *

Medium Trees (mature height 25'–50')

- *Acer miyabei* 'Morton'—State Street Miyabe Maple
- *Betula nigra* 'Cully'—Heritage River Birch
- *Betula nigra* 'Northern Tribute'—Northern Tribute River Birch *
- *Gleditsia triacanthos v. inermis* 'Halka'—Halka Honeylocust *
- *Gleditsia triacanthos v. inermis* 'Imperial'—Imperial Honeylocust
- *Gleditsia triacanthos v. inermis* 'Skyline'—Skyline Honeylocust
- *Gleditsia triacanthos v. inermis* 'Streetkeeper'—Streetkeeper Honeylocust
- *Nyssa sylvatica sp.*—Black Gum
- *Parrotia persica sp.*—Persian Ironwood

Small Trees (mature height <25')

- *Acer truncatum sp.*—Shantung Maple
- *Amelanchier arborea sp.*—Downy Serviceberry
- *Amelanchier laevis* —Allegheny Servicebery
- *Amelanchier × grandiflora*—Apple Serviceberry
- *Cercis canadensis sp.*—Eastern Redbud
- *Cornus kousa sp.*—Kousa Dogwood
- *Cratageus crus—galli* var. *inermis*—Thornless Cockspur Hawthorn
- *Cratageus viridis* 'Winter King'—Winter King Hawthorn *
- *Maackia amurensis* 'Starburst'—Starburst Amur Maackia
- *Prunus mackii* 'MN Strain'—Amur Chokecherry
- *Syringa reticulata* 'Ivory Silk'—Japanese Tree Lilac
- *Syringa reticulata* 'Summer Snow'—Japanese Tree Lilac

CANOPY TREES

Acer x fremanii 'Armstrong'
Armstrong Freeman Maple

Height: 40–60'

Spread: 10–15'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Armstrong Freeman Maple is a fast-growing, fastigiate hybrid of red and silver maples.

Acer x fremanii 'Celzam'
Celebration Freeman Maple

Height: 40–45'

Spread: 20–25'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Freeman Maple is a hybrid of red and silver maples. The cultivar 'Celzam' is recommended for its upright habit and superior resistance to wind and ice damage. This tree has shallow roots with a tendency to heave light pavements. Locate away from sidewalks.

Acer x fremanii 'Marmo'
Marmo Freeman Maple

Height: 40–75'

Spread: 35–45'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Freeman Maple is a hybrid of red and silver maples. The cultivar 'Marmo' is recommended for its upright habit and superior fall color. This tree has shallow roots with a tendency to heave light pavements. Locate away from sidewalks.

CANOPY TREES

***Acer x fremanii* 'Sienna'**
Sienna Glen Freeman Maple

Height: 40–50'

Spread: 30–45'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Sienna Freeman Maple is a pyramidal hybrid of red and silver maples. This tree has shallow roots with a tendency to heave light pavements. Locate away from sidewalks.

***Betula nigra* 'Cully'**
Heritage River Birch

Height: 40–70'

Spread: 30–40'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Acer rubrum has a low salt tolerance. Locate in areas subject to the lowest possible levels of winter salt applications on nearby pavements. This tree has shallow roots with a tendency to heave light pavements. Locate away from sidewalks. Many Acer rubrum cultivars exist. Not all are tolerant of Burlington's climate. Select a cultivar or straight-species tree, grown in USDA zone 3 or 4, that is known to tolerate Burlington's winter temperatures.

***Betula nigra* 'Northern Tribute'**
Northern Tribute River Birch

Height: 50–60'

Spread: 35–40'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Katsura is a difficult to transplant and drought-intolerant tree that requires irrigation, especially during establishment. Do not plant in an un-irrigated treebelt condition.

CANOPY TREES

Celtis occidentalis
Common Hackberry

Height: 40–60’

Spread: 40–60’

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Hackberry is resilient against salt and cold, but can be slow to heal wounds. Avoid using this tree in areas where automobile impacts or other significant injuries are anticipated.

***Celtis occidentalis* ‘Chicagoland’**
Chicagoland Hackberry

Height: 40–60’

Spread: 20–30’

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Good

VT Native: Yes

Notes: The Chicagoland cultivar was selected for its upright, single-trunked habit.

***Celtis occidentalis* ‘Prairie Pride’**
Common Hackberry

Height: 40–55’

Spread: 40–50’

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Good

VT Native: Yes

Notes: Prairie Pride is more resistant to Witches Broom than the species.

CANOPY TREES

Ginkgo biloba 'Autumn Gold'
Autumn Gold Ginkgo

Height: 40–50'

Spread: 20–30'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No

Notes: Autumn Gold is a fruitless, male cultivar.

Ginkgo biloba 'Magyar'
Magyar Ginkgo

Height: 40–50'

Spread: 20–25'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Good

VT Native: No

Notes: Magyar is a fruitless, male cultivar.

Ginkgo biloba 'Princeton Sentry'
Princeton Sentry Ginkgo

Height: 40–60'

Spread: 20–25'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Princeton Sentry is a fruitless, male cultivar.

CANOPY TREES

Gymnocladus dioicus
Kentucky Coffeetree

Height: 50–70'

Spread: 40–50'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Eastern US Native)

Notes: In locations where seed pods are undesirable, select a male cultivar such as 'Espresso.'

Platanus x acerifolia **'Morton Circle' Exclamation! London Planetree**

Height: 55–65'

Spread: 40–50'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 4.

This species is appropriate for bioretention/ raingarden use.

Quercus bicolor
Swamp White Oak

Height: 50–60'

Spread: 50–60'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: Yes

Notes: Swamp White Oak will not tolerate alkaline soils. Plant in a location with soil ph < 7.5. Consider the appropriateness of acorns in the streetscape context when selecting an appropriate site for this tree.

This species is appropriate for bioretention/ raingarden use.

CANOPY TREES

Quercus imbricaria
Shingle Oak

Height: 40–60'

Spread: 40–60'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Lawn

Salt Tolerance: Good

VT Native: No (Eastern US Native)

Notes: Shingle Oak will not tolerate saturated soils. Plant in a well-drained location. Consider the appropriateness of acorns in the streetscape context when selecting an appropriate site for this tree.

Quercus rubra
Northern Red Oak

Height: 50–75'

Spread: 50–60'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Red Oak will not tolerate saturated soils. Plant in a well-drained location. Consider the appropriateness of acorns in the streetscape context when selecting an appropriate site for this tree.

Taxodium distichium
Baldcypress

Height: 50–70'

Spread: 20–30'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Northeast Native)

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 4.

This species is appropriate for bioretention/ raingarden use.

CANOPY TREES

Tilia tomentosa
Silver Linden

Height: 50–70'

Spread: 30–55'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4.

***Ulmus americana* 'Princeton'**
Princeton American Elm

Height: 50–60'

Spread: 30–50'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: Yes

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4.

This species is appropriate for bioretention/ raingarden use.

***Ulmus x* 'Morton'**
Accolade Elm

Height: 50–60'

Spread: 30–40'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4.

This species is appropriate for bioretention/ raingarden use.

CANOPY TREES

***Ulmus x spp.* 'Morton Glossy'**
Triumph Elm

Height: 50–60'

Spread: 35–40'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4.

This species is appropriate for bioretention/ raingarden use.

***Ulmus x spp.* 'Patriot'**
Patriot Elm

Height: 40–50'

Spread: 20–25'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4.

This species is appropriate for bioretention/ raingarden use.

MEDIUM TREES

***Acer miyabei* 'Morton'**
State Street Miyabe Maple

Height: 30–40’

Spread: 30–40’

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: The cultivar ‘Morton’ is recommended for its superior cold-hardiness, symmetrical habit, and fall color.

***Betula nigra* ‘Cully’**
Heritage River Birch

Height: 40–50’

Spread: 30–35’

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: Yes

Notes: The cultivar ‘Cully’ is recommended for its superior cold tolerance and bark color. Single-stem trees are recommended for street tree planting. Lower branch pruning will be necessary for trees planted close to sidewalks. Do not plant in areas of high pedestrian traffic.

This species is appropriate for bioretention/ raingarden use.

***Betula nigra* ‘Northern Tribute’**
Northern Tribute River Birch

Height: 35–40’

Spread: 30–35’

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: Yes

Notes: An extremely cold tolerant Riverbirch. Single-stem trees are recommended for street tree planting. Lower branch pruning will be necessary for trees planted close to sidewalks. Do not plant in areas of high pedestrian traffic.

This species is appropriate for bioretention/ raingarden use.

MEDIUM TREES

Gleditsia triacanthos v. inermis
Halka Honeylocust

Height: 30–40'

Spread: 30–40'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Halka is a nearly fruitless, thornless Honeylocust cultivar.

Gleditsia triacanthos v. inermis
Imperial Honeylocust

Height: 25–30'

Spread: 30–35'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Imperial is a nearly fruitless, thornless Honeylocust cultivar. It is one of the most compact Honeylocusts.

Gleditsia triacanthos v. inermis
Skyline Honeylocust

Height: 35–45'

Spread: 30–35'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Skyline has a somewhat pyramidal form. It is a thornless and nearly fruitless Honeylocust cultivar.

MEDIUM TREES

Gleditsia triacanthos v. inermis
Streetkeeper® Honeylocust

Height: 45'

Spread: 20'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Good

VT Native: Yes

Notes: Streetkeeper is a a thornless and nearly fruitless Honeylocust cultivar with a unique, upright habit.

***Betula nigra* 'Cully'**
Heritage River Birch

Height: 30–50'

Spread: 20–30'

Required Soil Volume: 1000 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn, Bioretention

Salt Tolerance: Moderate

VT Native: Yes

Notes: Black Tupelo is a slow growing and somewhat low-branched tree. It has fantastic red fall color and is good for poorly-drained soils.

***Betula nigra* 'Northern Tribute'**
Northern Tribute River Birch

Height: 20–40'

Spread: 20–30'

Required Soil Volume: 1000 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Low

VT Native: No

Notes: Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 3 or 4. Parrotia has a low salt tolerance. Locate in areas subject to the lowest possible levels of winter salt applications on nearby pavements.

SMALL TREES

Acer truncatum **'Main Street'**
Shantung Maple

Height: 20–25'

Spread: 20–30'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Good under power lines. Compact, somewhat low-branched street tree.

Amelanchier arborea
Downy Serviceberry

Height: 15–25'

Spread: 15–25'

Required Soil Volume: 600 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: Yes

Notes: 'Spring Flurry' cultivar is recommended for its fastigiate form. Good under power lines in residential areas. Avoid areas of high soil compaction.

Amelanchier laevis sp.
Allegheny Servicebery

Height: 15–25'

Spread: 15–25'

Required Soil Volume: 600 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: Yes

Notes: 'Snowcloud' and 'Majestic' cultivars are recommended for their form and vigor. Good under power lines in residential areas. Avoid areas of high soil compaction.

SMALL TREES

Amelanchier x grandiflora
Apple Serviceberry

Height: 15–25'

Spread: 15–25'

Required Soil Volume: 600 ft^3

Planting Condition: Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No (Hybrid)

Notes: 'Autumn Brilliance' and 'Autumn Sunset' cultivars are recommended for their form and color. Good under power lines in residential areas. Avoid areas of high soil compaction.

***Cercis canadensis* 'MN Strain'**
Eastern Redbud

Height: 15–25

Spread: 15–25'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No (Eastern US Native)

Notes: Low-branched tree. Locate to avoid pedestrian conflicts. Must be "MN Strain" to be hardy here. Must be planted in a location protected from winter winds.

Cornus kousa sp.
Kousa Dogwood

Height: 15–20'

Spread: 15–20'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: A broad and low-branched tree. Locate to avoid pedestrian conflicts. Southern grown trees of this species may be cold-sensitive. Plant trees grown in USDA zone 4. Select cold-hardy cultivars.

SMALL TREES

Crataegus crus-galli var. inermis
CRUSADER Thornless Hawthorn

Height: 20–25

Spread: 20–25'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: Yes

Notes: Tough tree suitable for urban conditions, Requires good soil drainage. Thornless.

***Crataegus viridis* 'Winter King'**
Winter King Hawthorn

Height: 20–25'

Spread: 20–25'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No (Eastern US Native)

Notes: Tough tree suitable for urban conditions, Requires good soil drainage. Thorny. Lower branches will require pruning when planted near sidewalks.

This species is appropriate for bioretention/raingarden use.

***Syringa reticulata* 'Summer Snow'**
Japanese Tree Lilac

Height: 15–20'

Spread: 15–20'

Required Soil Volume: 600 ft^3

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Cultivar is smaller than the species. Attractive bark and heavy summer bloom. May reseed. Do not plant near natural areas.

SMALL TREES

***Maackia amurensis* 'Starburst'**
Starburst Amur Maackia

Height: 20–25'

Spread: 20–25'

Required Soil Volume: 600 ft³

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Slow growing. Good under power lines.

Prunus mackii sp.
Amur Chokecherry

Height: 20–30'

Spread: 18–25'

Required Soil Volume: 600 ft³

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Requires pruning to maintain tree form. White spring flowers & beautiful exfoliating bark.

***Syringa reticulata* 'Ivory Silk'**
Japanese Tree Lilac

Height: 20–25'

Spread: 15–20'

Required Soil Volume: 600 ft³

Planting Condition: Brick Treebelt, Broad Treebelt, Turf Treebelt, Narrow Treebelt, Lawn

Salt Tolerance: Moderate

VT Native: No

Notes: Cultivar is slightly smaller than the species. Attractive bark and heavy summer bloom. May reseed. Do not plant near natural areas.

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OTHER PLANT SPECIES

Note: an asterisk (*) next to a species indicates that it is appropriate for bioretention/rain garden use.

Perennials

- *Achillea millefolium* —Common Yarrow
- *Acorus americanus*—Sweetflag *
- *Agastache foeniculum*—Anise Hyssop
- *Allium cernuum*—Nodding Onion
- *Asclepias tuberosa*—Butterfly Weed *
- *Aster novae-angliae*—New England Aster
- *Aster divaricatus*—White Wood Aster
- *Aquilegia canadensis* —Columbine
- *Baptisia australis*—Blue False Indigo
- *Callirhoe involucrata* —Winecups
- *Coreopsis tripteris* 'Gold Standard'—Tall Tickseed
- *Echinacea purpurea* —Purple Coneflower
- *Eryngium yuccifolium*—Rattlesnake Master
- *Helianthus divaricatus*—Sunflower
- *Heuchera macrorhiza* 'Autumn Bride'—Autumn Bride Coral Bells
- *Heuchera longiflora*—Longflower Alumroot
- *Iris versicolor*—Blueflag *
- *Liatris spicata*—Spike Gayfeather *
- *Lobelia cardinalis*—Cardinal Flower *
- *Lupinus perennis*—Sundial Lupine
- *Monarda bradburiana*—Eastern beebalm *
- *Monarda didyma*—Beebalm *
- *Monarda fistulosa*—Wild Bergamot *
- *Oenothera fruticosa*—Sundrops
- *Penstemon digitalis*—Beardtongue *
- *Phlox subulata*—Moss Phlox
- *Rudbeckia fulgida*—Black Eyed Susan *
- *Salvia nemorosa*—Garden Sage
- *Sedum* 'Autumn Joy'—Autumn Joy Sedum
- *Solidago sempervirens* —Seaside Goldenrod *

Grasses

- *Bouteloua curtipendula* —Sideoats Grama
- *Bouteloua gracilis*—Blue Grama Grass
- *Chasmanthium latifolium*—Northern Sea Oats *
- *Juncus effusus* —Soft Rush *
- *Juncus tenuis* —Poverty Rush *
- *Panicum* 'Cape Breeze' —Cape Breeze Switchgrass *
- *Schizachyrium scoparium* —Little Bluestem *

Shrubs

- *Aronia melanocarpa*—Black Chokeberry *
- *Clethra alnifolia* —Sweet Pepperbush *
- *Cornus racemosa*—Gray Dogwood *
- *Cornus sericea* —Redtwig Dogwood *
- *Hamamelis virginiana* —Witchhazel
- *Hypericum kalmianum*—Kalm's St. John's wort
- *Hypericum prolificum*—Shrubby St. John's Wort
- *Ilex glabra* —Inkberry Holly *
- *Ilex verticillata* —Winterberry Holly *
- *Myrica pensylvanica* —Bayberry *
- *Physocarpus opulifolius*—Ninebark
- *Prunus maritima*—Beach Plum *
- *Rhus aromatica* 'Gro-Low' —'Gro-Low' Fragrant Sumac *
- *Salix discolor*—Pussy Willow *
- *Viburnum dentatum*—Arrowwood *
- *Viburnum lentago*—Nannyberry Viburnum *
- *Yucca filamentosa*—Adam's Needle

Vines

- *Parthenocissus quinquefolia* —Virginia Creeper *
- *Lonicera sempervirens*—Trumpet Honeysuckle
- *Hydrangea arborescens*—Climbing Hydrangea
- *Humulus lupulus var*—Hops, Magnum or Cascade

Examples of Proposed Plant Species

Allium cernuum—Nodding Onion

Aster novae angliae—White Wood Aster

Baptisia australis—Blue False Indigo

*Monarda bradburiana—Eastern Beebalm **

Sedum 'Autumn Joy'—Autum Joy Sedum

Bouteloa gracilis—Sideoats Grama

*Chasmanthium latifolium—Northern Sea Oats **

*Juncus effusus— Soft Rush**

*Panicum 'Cape Breeze'—Cape Breeze Switchgrass **

*Clethra alnifolia—Sweet Pepperbush **

Hamamelis virginiana—Witchhazel

*Ilex glabra—Inkberry Holly **

*Ilex verticillata—Winterberry Holly **

*Myrica pennsylvanica—Bayberry **

*Rhus aromatica—Fragrant Sumac **

*Salix discolor—Pussy Willow **

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Stormwater

Toolkit

Given the economic, aesthetic, and health impacts of water pollution, compounded by climate change and more frequent and heavy rain, the City of Burlington is working to identify new ways to manage stormwater more effectively. The most efficient and cost-effective way to do this is through small scale, landscape-based stormwater practices throughout the city to collect and manage stormwater where it falls.

Increasing the amount of urban vegetation will send more water into the air as vapor through either evaporation or transpiration from plants. This will both reduce the overall volume of runoff that is generated by rainfall and cool the air. Trees are the first line of defense for these processes by allowing leaves and branches to capture rainfall before it hits the ground. Other ground plane vegetation systems, such as grass, rain gardens, swales, and planters, can significantly improve storm water management compared to hardscape when they are designed to capture stormwater runoff. Where hardscape is necessary to provide stabilized and accessible walking surfaces, strong consideration should be given to pervious pavement systems.

There are many important considerations when selecting the right type of vegetation, including resistance to vehicular emissions and salt; tolerance to drought and inundation; sight line requirements; the ability to remediate pollutants; resistance to insects and disease; and the amount of maintenance required.

The stormwater strategies described in this section are related to each other and should be customized for specific locations, both urban downtown and residential conditions. A street may have more than one stormwater strategy that is appropriate for the site and often multiple strategies are used to maximize the amount of stormwater captured, filtered, and infiltrated. Because most of the downtown study area is within Burlington's Combined Sewer Area, it is important to infiltrate and delay the flow of stormwater entering the piped system to lessen the burden on the City's main Wastewater Treatment Plant.

Landscape architects and civil engineers must survey existing soil and drainage conditions, create an overall drainage and recharge plan, and specify the various components according to the opportunities and constraints for a particular project and location. The goal is to not only manage stormwater runoff in a more sustainable and cost-effective way, but to also create beautiful and safe streets for downtown Burlington. The City should consider ways to embed public engagement, public art, or other interpretive elements into these treatments to communicate the importance of these treatments.

Maintenance requirements can include, but are not limited to:

- Removal of sediment, litter, and debris as needed. Ideally this would be done at a minimum on a quarterly basis.
- Clean out of pretreatment areas and forebays twice per year. Once after leaf fall (approx. Nov 15) and once in the spring after snow melt (approx. May 1). More frequent visits may be needed on certain streets that have considerable leaf debris throughout the year.
- Annual replacement of dead plants and mulch, as needed.
- Weeding of landscape as needed, but at least once a year.
- Aeration and/or replacement of soils if clogging or standing water are observed for more than 48 hours after a rain event.
- Inspection of inflow and overflow points, and other structural components such as check dams, should occur every three months, and after large rain events.
- Spring cleaning if area is frequently covered with snow accumulation. It is highly preferred that stormwater landscapes NOT be sites for storing snow as it will greatly diminish their functional lifespan. Close coordination with Public Works should take place to find alternative sites for dumping snow.

Species that may be considered for any facilities that include planted material within them can be found in *"Tree Species Under Consideration" on page 195* and *"Other Plant Species" on page 212.*

Stormwater Toolkit Matrix

		Downtown Residential Streets		Commercial Streets	Other Streets	
		Single-Family	Multi-Family	Minimum Slow Slow (w/ transit) Special Major	Alleys	Pedestrian-Only Streets
ROADWAY ZONE	**Stormwater Curb Extensions**	●	●	●		
	Green Gutters	●			●	●
	Rain Gardens	●	●	●		●
	Pervious Pavers in Parking Zone *(Pilot before expanding to other areas)*	●			●	
PEDESTRIAN ZONE	**Pervious Pavers in Treebelt Zone**		●	●		●
	Stormwater Planters w/o Street Parking	●	●	●		●
	Stormwater Planters w/ Street Parking		●			
	Tree Pit Stormwater Planters		●	●		●
	Tree Trench Stormwater Planters (Vegetated Swales)		●	●		●
	Tree Grates in Stormwater Planters			●		●

Roadway Zone

STORMWATER CURB EXTENSIONS

Stormwater curb extensions are landscape areas that extend into the street's parking zone to capture stormwater runoff. Conventional curb extensions (e.g., bulb outs, chokers, chicanes) are commonly used to increase pedestrian safety and help calm traffic. A stormwater curb extension shares these same attributes plus adds a stormwater benefit by allowing water to flow into the landscape space. In Burlington's downtown area, stormwater curb extensions should be considered at many intersections and mid-block locations, even if there are existing conventional curb extensions already in place.

The landscape space and profile of stormwater curb extensions can be designed with the physical characteristics of vegetated swales with 4:1 side slopes (see page *page 234*) or stormwater planters with vertical conditions, or a hybrid of both, depending on the available space and specific site conditions.

Stormwater curb extensions are particularly advantageous in retrofit situations because they can often be added to existing streets with minimal disturbance. The small footprint of stormwater curb extensions allows for an efficient stormwater management system that often performs very well for a relatively low implementation cost.

Stormwater curb extensions can be used in a variety of land uses from low-density residential streets to highly urbanized commercial streetscapes. Curb extensions are excellent to use in Burlington's steeper slope conditions because they can act as a "backstop" for capturing runoff from a curbline's upstream flow. Stormwater curb extensions can be planted with a variety of trees, shrubs, grasses and groundcovers depending on site context and conditions and in accordance with the appropriate maintenance cycle.

Urban stormwater curb extensions are often designed to be shorter in length and smaller in size than residential stormwater curb extensions to balance the need for on-street parking. Stormwater curb extensions can be placed intermittently along a street in order to support street trees within the parking zone at regular frequency. Stormwater curb extensions can be spatially confined just to the street's parking zone or they can reach into the tree belt zone for additional landscape space. If there are mature trees already present within the tree belt zone, it is common practice to only extend into the parking zone to avoid disturbing existing tree roots. Stormwater curb extensions can also be integrated with other amenities, such as interesting seating arrangements, artwork, information kiosks, etc., to create a parklet space.

An urban street with stormwater curb extensions at a street intersection that incorporate pedestrian ramps.

An urban street with stormwater curb extensions that captures the tree belt zone with new street trees and extends out into the street.

A residential street with stormwater curb extensions that only extends out into the street to preserve the existing street trees.

Key Design Considerations

Dimensional Requirements

4' minimum, 8' ideal, cross section width. Minimum length to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and balanced against the desired amount of parking spaces.

Stormwater Entry

A 2' minimum width standard curb cut at the flowline of the street to allow runoff to enter the curb extension. Surface grading around the curb cut should freely direct water through the curb cut.

Sediment Forebay

3' square flat-bottom concrete forebay pad should be placed immediately downstream of the entry curb cut 4" lower than the street gutter grade to allow for sediment to drop out onto the concrete pad before entering the landscape area. Vegetation can also be placed around the concrete pad to act as a natural dam to incent sediment and trash particles to settle in the forebay area. The inlet design shall ensure flow is directed into the system in a non-erosive manner.

Water Retention Depth

Maximum water retention depth should be 6" of water and can be controlled using check dams and weirs. Stormwater curb extensions should have check dams installed for street slopes over 2%. For streets slopes over 5%, the interior of the curb extensions should be terraced with check dams and act more as a series of planters.

Grading Considerations

Grade changes directly abutting pedestrian walkways should transition at a maximum 4:1 side slope towards the facility's lowest elevation. Grade changes from the vehicular side of the curb extension should also transition at a 4:1 side slope and match the street grade elevation prior to grade transition. In some cases where terracing the grade is desirable, creating a flat-bottom grading condition with respect to the street-side curb can be achieved, but care should be taken to not have an overly deep grading condition.

Compost

Low-P compost (<0.5% P dry weight basis) is required in bioretention planting areas for the establishment phase. Allowable Phosphorous (P) content for bioretention media is 12 to 30 mg/kg per Mehlich III (or equivalent) test. (Source MnDOT 3890) Low-P compost can be created using yard, leaf, and wood waste. Manures, biosolids, and food waste are not acceptable sources for Low-P compost.

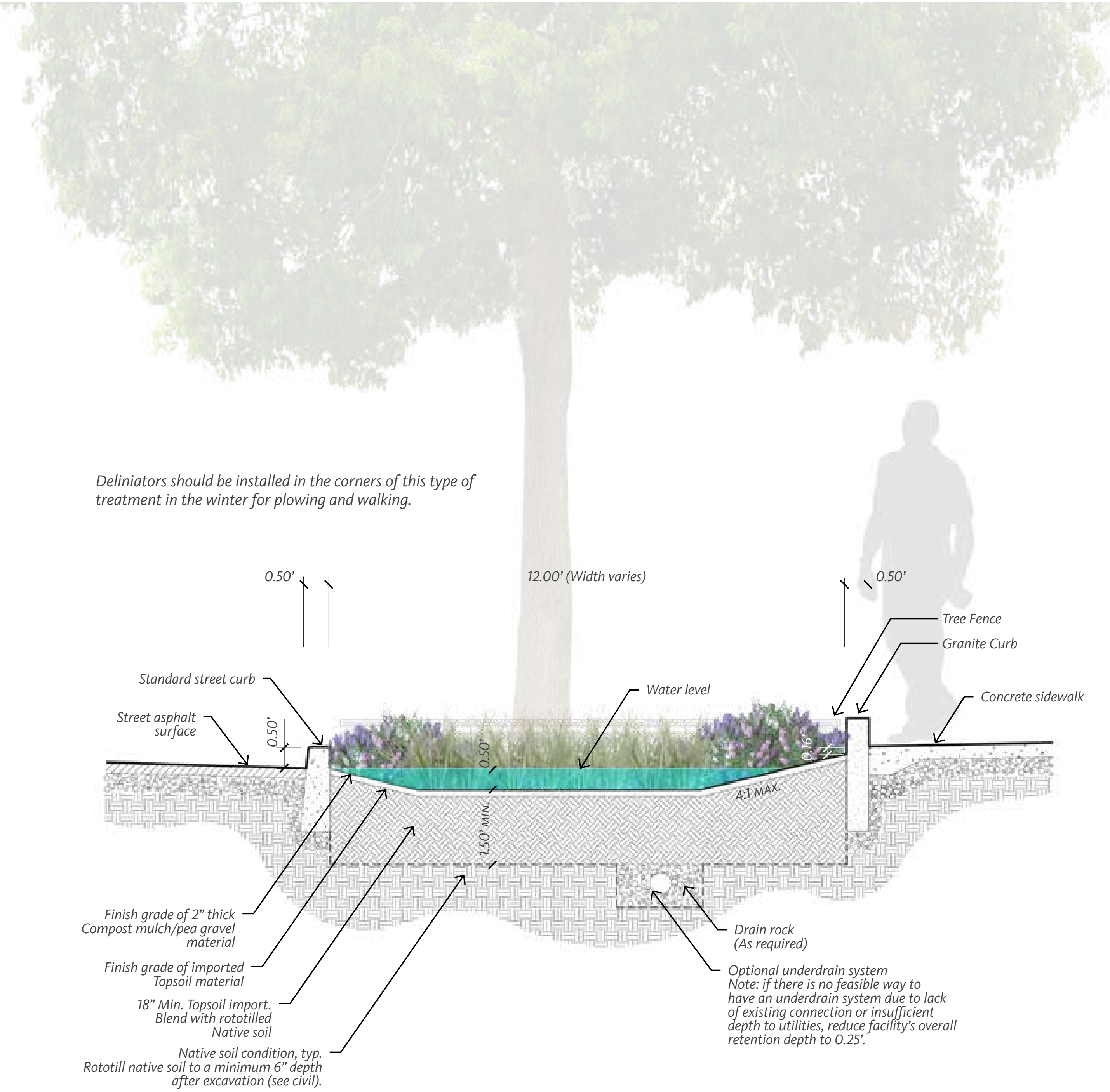
Reference Drawings

See ref. dwg. **SW–01A & B Stormwater Curb Extension (No Capture of Landscape Strip)** in *Appendix section A-6*.

See ref. dwg. **SW–02A & B Stormwater Curb Extension (Capturing Landscape Strip)** in *Appendix section A-6*.

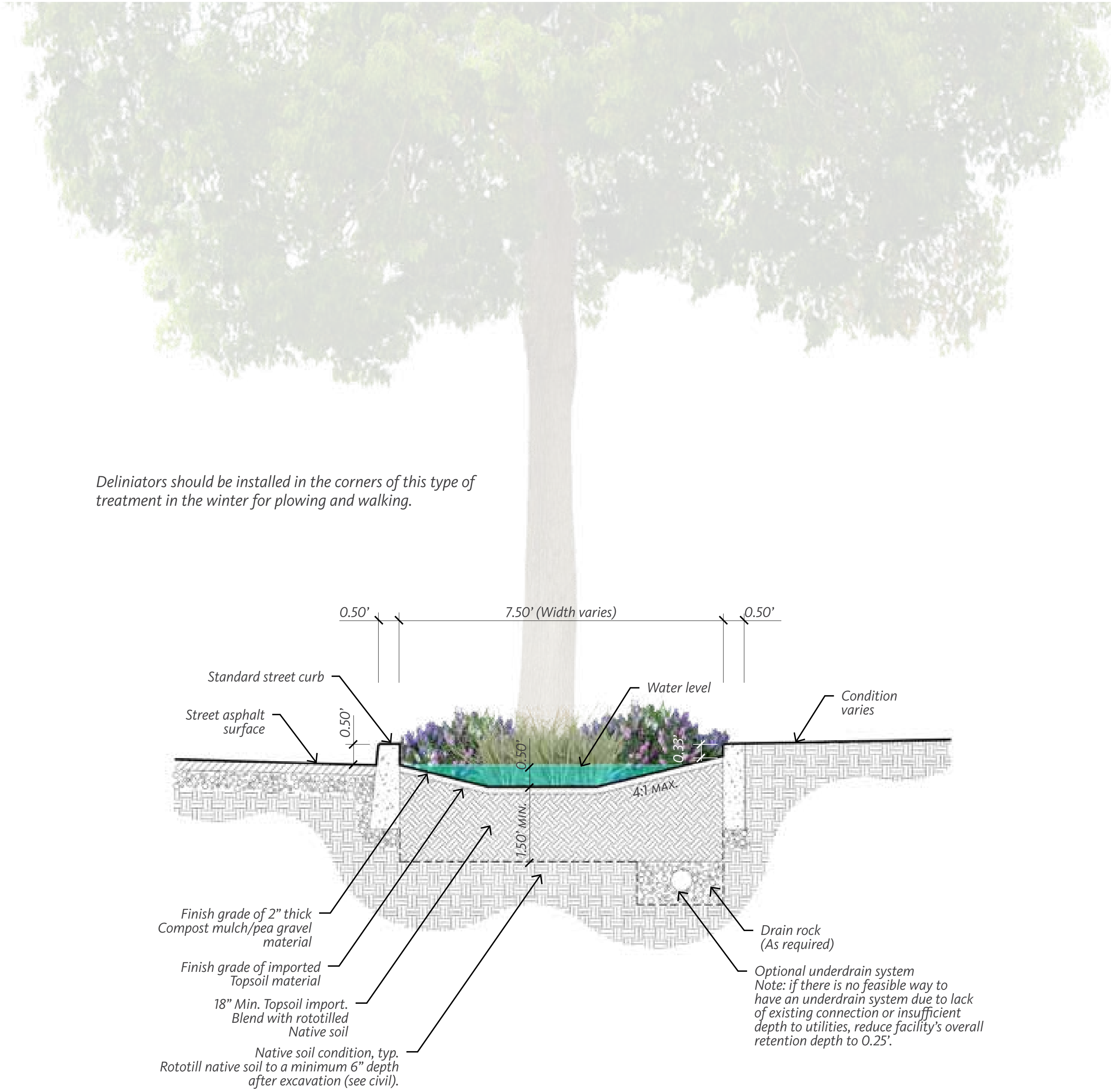
Stormwater Curb Extension Section (Capturing Landscape Strip)

This condition captures portion of sidewalk/furnishing zone runoff.



Stormwater Curb Extension Section (No Capture of Landscape Strip)

This condition does not capture portion of sidewalk/furnishing zone runoff.



GREEN GUTTERS

Green gutters are narrow landscape systems along a street's curbline that capture and slow stormwater flow. Green gutters are used on streets that do not have adjacent on-street parking and can fit along the curbline between driveway locations, if any.

Typically less than three feet wide, green gutters most resemble planters in that they are confined by vertical curbs and have a flat-bottom profile. Unlike typical planters, however, green gutters are designed to be very shallow. Green gutters can be designed as curbless systems (on streets without on-street parking, and with or without bike facilities adjacent to the curb) or with a standard raised curb (on streets with on-street parking).

The most promising use of green gutters is along excessively wide streets that do not require, or need, on-street parking. In downtown Burlington, there are several residential streets that have street parking only on one side of the street or do not allow any on-street parking. The travel lanes on some of these streets can be narrowed enough to yield room for a green gutter application, or combining this asphalt reduction with existing landscape area can also provide space for a green gutter application.

Green gutters have other benefits besides filtering stormwater pollutants and infiltrating runoff from roadways. They also introduce more green space along streets that lack landscaping. Furthermore, these narrow strips of green help provide a landscape buffer between auto traffic and pedestrians, resulting in a more desirable and potentially safer condition for people.

A curbless residential green gutter separates vehicular traffic from the sidewalk zone.

A residential green gutter on a steep street that uses check dams and weirs to terrace the street grade.

A residential bike and pedestrian path with a curbless green gutter accepting sheet flow of runoff.

Key Design Considerations

Dimensional Requirements
1.5' minimum, 3' maximum, cross section width. Minimum length to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and the ability to fit the green gutter system between driveway locations.

Stormwater Entry
If curbs are required, place 2' minimum width standard curb cuts at the flowline of the street at regular frequencies to allow runoff to enter the green gutter. Surface grading around the curb cuts should freely direct water through the curb cut. If the green gutter is a flush condition, make sure that there is a continuous minimum 2" drop from the flow line to the top of mulch to direct sheet flow into the landscape.

Sediment Forebay
If sheet flow is used, no sediment forebay is required. If curb cuts are used, 1.5' square flat-bottom concrete forebay pads should be placed immediately downstream of the entry curb cuts 2" lower than the street gutter grade to allow for sediment to drop out onto the concrete pad before entering the landscape area. Vegetation can also be placed around the concrete pad to act as a natural dam to allow sediment and trash particles to settle in the forebay area. The inlet design shall ensure flow is directed into the system in a non-erosive manner.

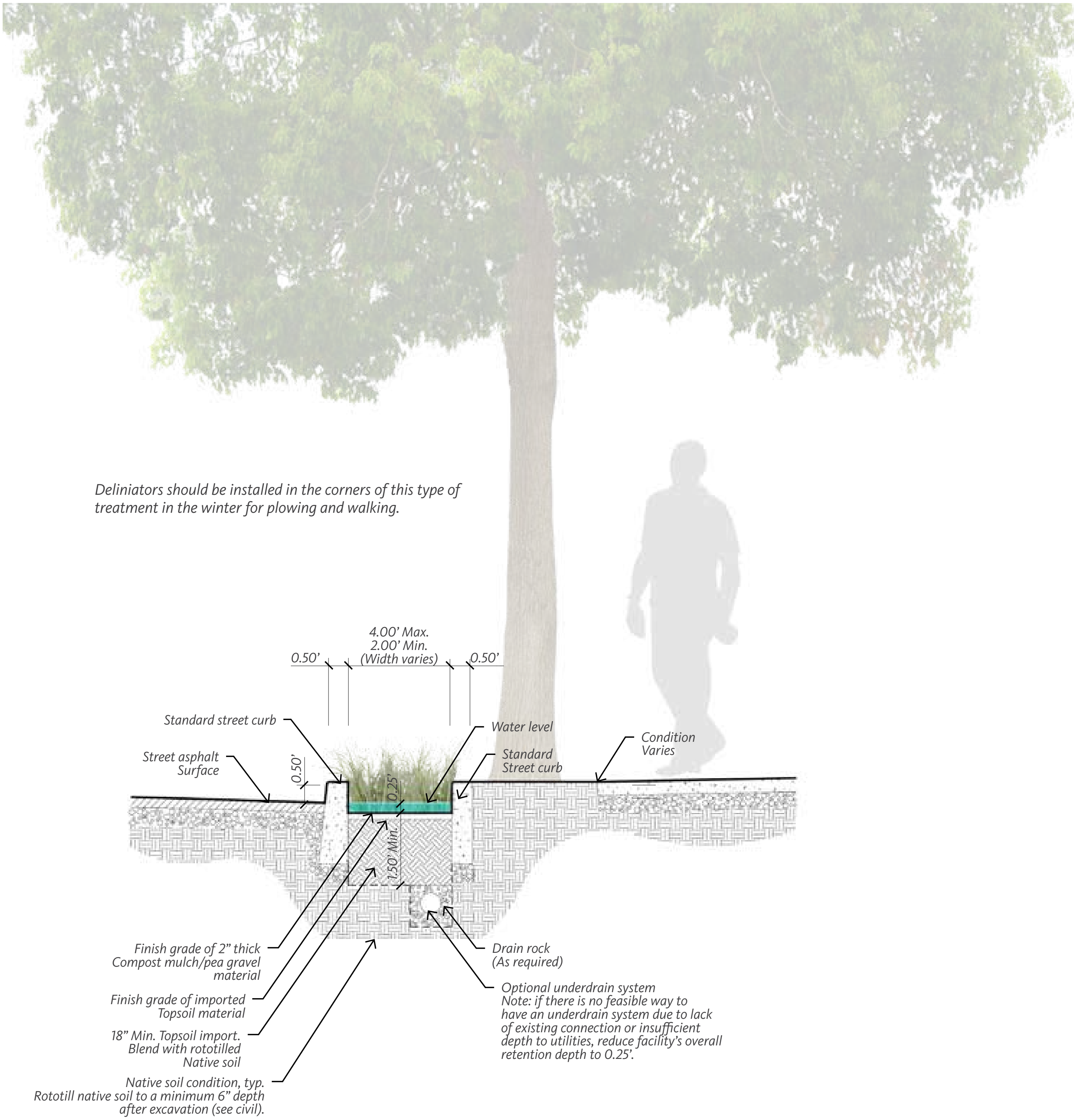
Water Retention Depth
Maximum water retention depth should be 6" of water and can be controlled using check dams and weirs. Stormwater curb extensions should have check dams installed for street slopes over 2%. For streets slopes over 5%, the interior of the curb extensions should be terraced with check dams and act more as a series of planters.

Grading Considerations
The cross section grades in green gutters should be flat with a 2" vertical drop in grade from the street grade.

Reference Drawings
See ref. dwg. **SW–03A & B Green Gutter (With Raised Street Curb)** in *Appendix section A-6*.

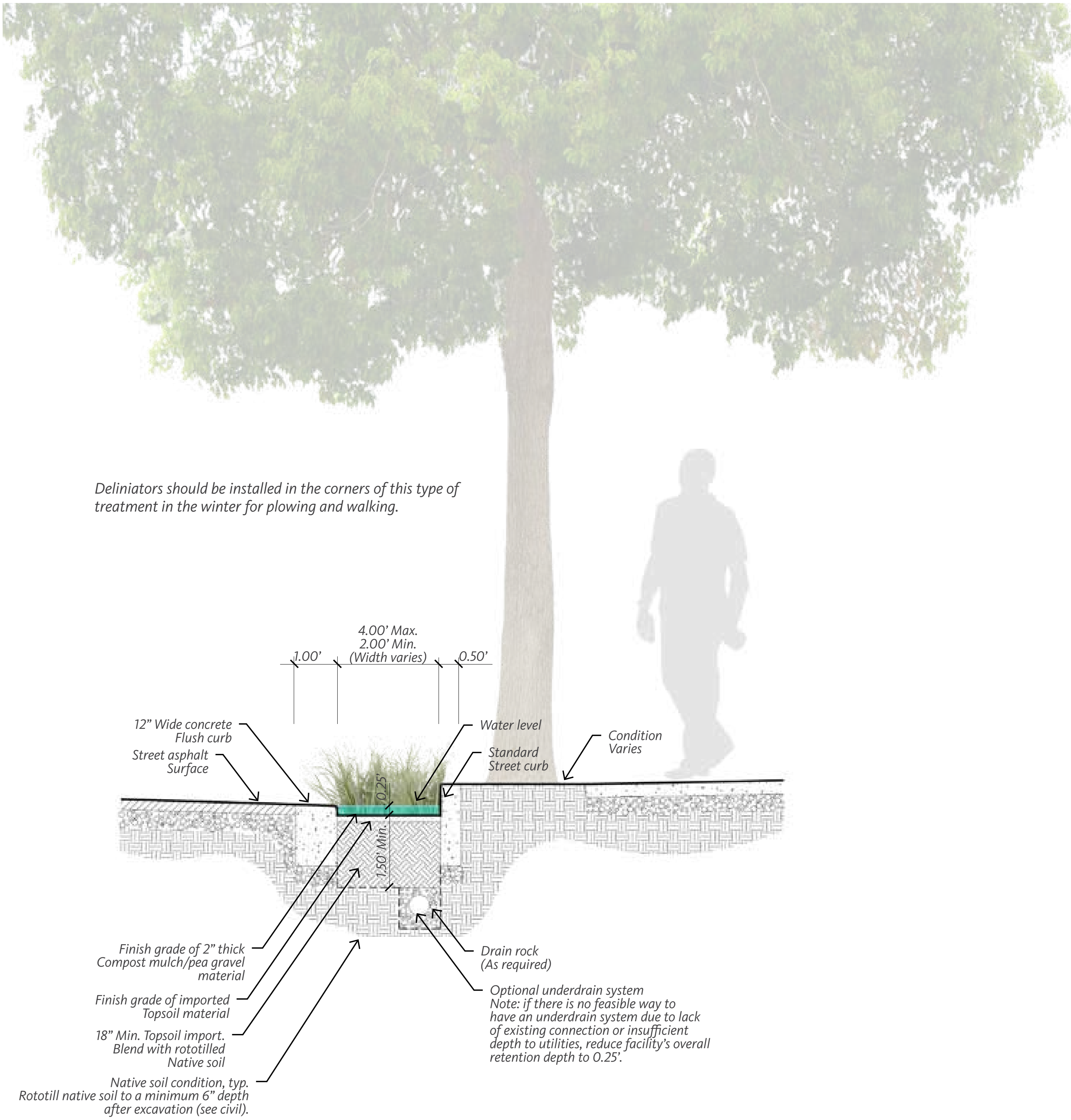
See ref. dwg. **SW–04A & B Green Gutter (With Raised Street Curb)** in *Appendix section A-6*.

Green Gutter Section (With Raised Street Curb—Adjacent to Parking)



Green Gutter Section (With Flush Street Curb—No Adjacent Parking)

This option should only be used on streets where no on-street parking is adjacent to the curb, but it can be used where bike infrastructure is adjacent to the curb.



RAIN GARDENS

Rain gardens are large, shallow, vegetated depressions in the landscape. They can be any size or shape, and are often designed to occupy "leftover" spaces along street frontages, plazas, and in situations where street geometries intersect at odd angles, such as areas near intersections on streets with angled parking zones. They are also typically designed to be flat-bottomed without any longitudinal slope in order to maximize storage potential for stormwater.

Rain gardens retain stormwater, thereby attenuating peak flows and overall volume. They can also allow for infiltration, depending on the capacity of the native soil. Although rain gardens can share certain characteristics with swales and planters (they can be designed with vertical curbs or side slopes), they differ from swales in that their primary function is the maximum storage of runoff, not conveyance.

The primary advantage of rain gardens is their versatility in size and shape. Because rain gardens are larger in size, they can potentially cost more than other stormwater facility options, but they also manage correspondingly larger volumes of stormwater. Hence, they can offer a good value. Simple rain garden applications that do not use extensive hardscape or pipe infrastructure can be very cost effective to install.

It is best if rain gardens allow for natural infiltration. However, if infiltration is not possible, rain gardens can also be designed as a flow-through system with an underdrain.

Key Design Considerations

Dimensional Requirements
Minimum length and width to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and the ability to fit the rain garden between street amenities and utilities.

Stormwater Entry
A 2' minimum width standard curb cut at the flowline of the street allow runoff to enter the curb extension. Surface grading around the curb cut should freely direct water through the curb cut.

Sediment Forebay
3' square flat-bottom concrete forebay pad should be placed immediately downstream of the entry curb cut 4" lower than the street gutter grade to allow for sediment to drop out onto the concrete pad before entering the landscape area. Vegetated can also be placed around the concrete pad to act as a natural dam incent sediment and trash particles to settle in the forebay area.

A large rain garden can often fit within existing under-utilized space at street corners.

A beautifully integrated rain garden retrofit in Portland, Oregon helps form this plaza space.

A triangle-shaped rain garden conforms to angled parking configuration. Note that there is extra space allocated to step out of the side vehicle parking space.

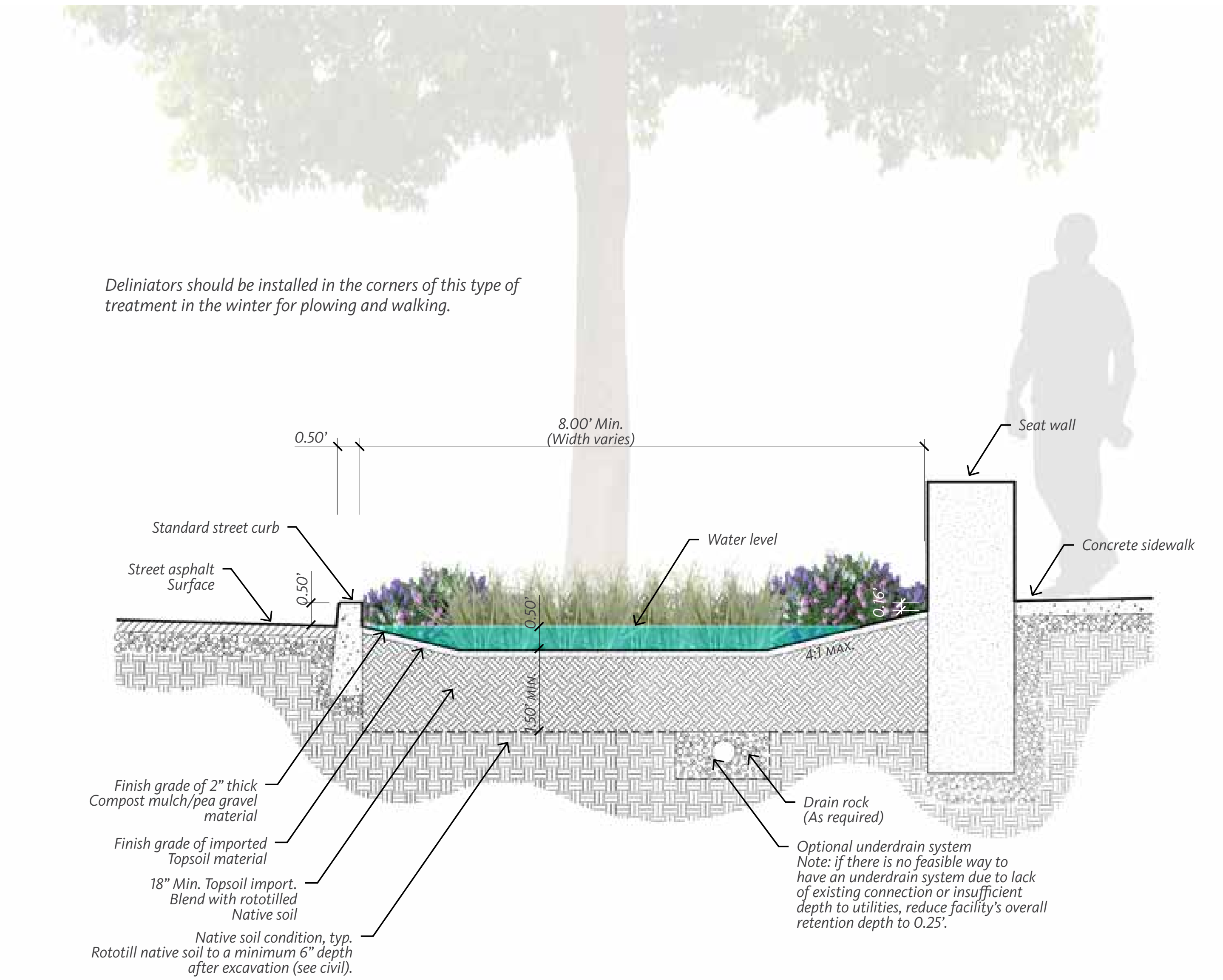
Water Retention Depth

Maximum water retention depth should be 8” of water and can be controlled using check dams and weirs. Rain gardens should have check dams installed for street slopes over 2%. For streets slopes over 5%, the interior of the rain garden should be terraced with check dams and act more as a series of planters.

Grading Considerations

Grade changes directly abutting pedestrian walkways should transition at a maximum 4:1 side slope towards the facility’s lowest elevation. Any vertical grade changes more than 7” should require exposed curbs or low-railings to help protect pedestrians from abrupt grade changes. Grade changes from the vehicular side of the rain gardens should also transition at a 4:1 side slope and match the street grade elevation prior to grade transition. In some cases where terracing the grade is desirable, creating a flat-bottom grading condition with respect to the street-side curb can be achieved, but care should be taken to not have an overly deep grading condition.

Rain Garden Section

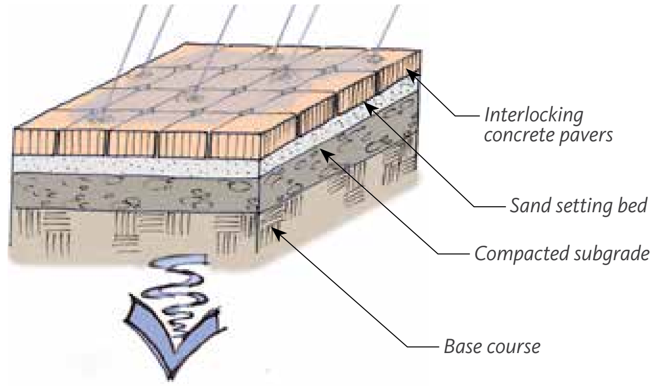


PERVIOUS PAVERS IN PARKING ZONE (PILOT)

Parking zones are excellent applications for interlocking concrete pervious paver systems. Many interlocking concrete unit pavers are designed specifically for stormwater management applications. They allow water to pass through joint gaps that are filled with small aggregates and infiltrate into a thick gravel subgrade. This system is widely applicable to both small and large paving applications and it offers the flexibility to be repaired because small sections can be removed and replaced. Interlocking concrete unit pavers offer flexibility in color, style, joint configuration, and paving pattern.

It is important to note that selected pervious joint pavers along pedestrian areas must be ADA-compliant and not cause tripping hazards. When installing pervious joint pavers, care should be taken to assure that the base and subgrade is properly constructed to minimize the potential for differential settlement. Regular vacuum cleaning of the paver joints will help prevent clogging and extend the longevity of the system.

Pervious paving within the parking zones of streets can be combined with other curb zone landscape stormwater treatments such as stormwater curb extensions and green gutters to maximize the potential for stormwater management.



Key Design Considerations

This treatment should be piloted in alleys or on low volume streets before applying this treatment broadly throughout downtown. This treatment may only be applied in consultation with the Department of Public Works until such time it is no longer indicated as a pilot in these standards.

Vehicle Loading Requirements
Pervious paving systems need to maintain H-20 vehicle loading capability.

Maximum Gap Between Pavers
A ½” maximum gap is to be maintained between pavers to be ADA compliant. A ¼" gap is preferred where pedestrians will traverse.

Minimum Gravel Sub-base Depth
A 12” minimum gravel sub-base is necessary under parking zone pervious paving systems.

Edge Conditions
Concrete band is required where pavers meet asphalt edge and granite curb, which typically doesn't incorporate concrete gutter (see photos at right).

A residential street with interlocking concrete pavers within the parking zone.

A urban street with interlocking concrete pavers within the parking zone and tree belt zone.

Pedestrian Zone

PERVIOUS PAVERS IN TREEBELT ZONE

Sidewalk tree belt zones on urban streets are excellent applications for interlocking concrete pervious paver systems. Many interlocking concrete unit pavers are designed specifically for stormwater management applications. They allow water to pass through joint gaps that are filled with small aggregates and infiltrate into a thick gravel subgrade. This system is widely applicable to both small and large paving applications and it offers the flexibility to be repaired because small sections can be removed and replaced. Interlocking concrete unit pavers offer flexibility in color, style, joint configuration, and paving pattern. Along streets that utilize salt in winter conditions, only clay pavers should be used.

It is important to note that selected pervious joint pavers along pedestrian areas must be ADA-compliant and not cause tripping hazards. When installing interlocking concrete pavers, care should be taken to assure that the base and subgrade is properly constructed to minimize the potential for differential settlement. It is important to design the pervious paver system sub-base to allow for the infiltration of stormwater, but also be able to consistently support the weight of occasional emergency and/or heavy duty utility vehicles traversing its surface and not allow pavers to buckle over time. Regular vacuum cleaning of the paver joints will help prevent clogging and extend the longevity of the system. In addition, periodic replenishment of the joints with fill sand/stones will help maintain structural stability over time.

Pervious paving within the tree belt zones of streets can be combined with other sidewalk landscape stormwater treatments such as stormwater planters and tree grate stormwater planters to maximize the potential for stormwater management.

Key Design Considerations

Vehicle Loading Requirements
Pervious paving systems need to maintain H-20 vehicle loading capability.

Maximum Gap Between Pavers
A ¼" gap is preferred where pedestrians will traverse. A ½" maximum gap is to be maintained between pavers to be ADA compliant.

Minimum Gravel Sub-base Depth
A 12" minimum gravel sub-base is necessary under parking zone pervious paving systems. Compact base material to allow for enough structural support, but to also allow for infiltration.

Pervious brick pavers in the tree belt zone on S. Winooski Ave. This example accepts sheet flow from non-pervious sidewalks.

An urban street with a centralized tree belt zone with granite pavers separated by ½" wide joints to capture stormwater runoff.

STORMWATER PLANTERS

Stormwater planters are narrow, flat-bottomed, often rectangular, landscape areas used to treat stormwater runoff. Their most distinguishing feature is that the side slopes typically used in stormwater swales are replaced with vertical side walls. This allows for more storage volume in less space.

There are two types of planters used for stormwater management: infiltration and flow-through planters. Infiltration planters depend on native soil conditions that allow runoff to soak into the underlying soil. Flow-through planters are completely contained systems that only allow runoff to soak through the planter's imported soil bed and then into an underdrain system. Infiltration planters are more desirable because they allow for greater volume reduction and further ease the burden on local storm drain facilities. Flow-through planters should be used where native soil conditions are unfavorable to infiltration, where there is underlying soil contamination, where there is close proximity to older buildings with stone foundations, and/or where the seasonal high water table is within 10 feet of the landscape surface.

For Burlington, stormwater planters can be easily incorporated into retrofit conditions and in places where space is limited primarily in downtown urban conditions. If carefully designed to be in context, they can also work well in residential areas. Stormwater planters can be built to fit between driveways, utilities, existing trees and other site elements. Placement, size, and grading of sidewalk planters varies depending on the width of the sidewalk and the source of the runoff. Stormwater planters can be planted with a simple palette of sedges and/or rushes or a mixture of trees and shrubs. Stormwater planters that primarily support the growth of trees are called tree pits or tree trenches. Because planters have no side slopes and are contained by vertical curbs, it is best to use plants that will grow at least as tall as the planter's walls to help "soften" the edges. Planters can be used in both relatively flat conditions and in steep conditions if they are appropriately terraced.

Stormwater planters can be utilized along streets with or without on-street parking. When being used with on-street parking, careful design should be taken to allow for adequate pedestrian circulation around and beside the stormwater planters. If there is more than 6" of vertical drop in grade from the sidewalk zone, there should be some vertical detection of this condition with either raised curbs or low-railings to alert pedestrians.

An urban street plaza with stormwater planters and metal grates used for frequent pedestrian crossings.

A small stormwater planter with a single curb cut that allows street water to enter/exit. (PILOT)

A urban stormwater planter system that captures street and sidewalk runoff also has notched areas for seating.

Key Design Considerations

Dimensional Requirements

5' minimum, 10' maximum, cross section width. Minimum length to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and the ability to fit the vegetated swale system between driveway locations.

Stormwater Entry

Roadway runoff is **NOT** permitted in sidewalk tree wells, unless implemented as pilot project. Pilot project would require the placement of 2' minimum width standard curb cuts at the flowline of the street at regular frequencies to allow runoff to enter the vegetated swale. Surface grading around the curb cuts should freely direct water through the curb cut.

Sediment Forebay

If curb cuts are used, 1.5' square flat-bottom concrete forebay pads should be placed immediately downstream of the entry curb cuts 2" lower than the street gutter grade to allow for sediment to drop out onto the concrete pad before entering the landscape area. Vegetated can also be placed around the concrete pad to act as a natural dam incent sediment and trash particles to settle in the forebay area.

Water Retention Depth

Maximum water retention depth should be 6" of water and can be controlled using check dams and weirs. Vegetated swales should have check dams installed for street slopes over 2%. For streets slopes over 5%, the interior of the vegetated swales should be terraced with check dams and act more as a series of planters.

Grading Considerations

Grade changes directly abutting pedestrian walkways should transition at a maximum 4:1 side slope towards the facility's lowest elevation. Grade changes from the vehicular side of the curb extension should also transition at a 4:1 side slope and match the street grade elevation prior to grade transition.

Curbing and Fencing

A barrier is necessary to prevent trash and debris from collecting in these planters, and to ensure pedestrians do not inadvertently step into them. See *"Tree Well Curb & Fence Details" on page 186*.

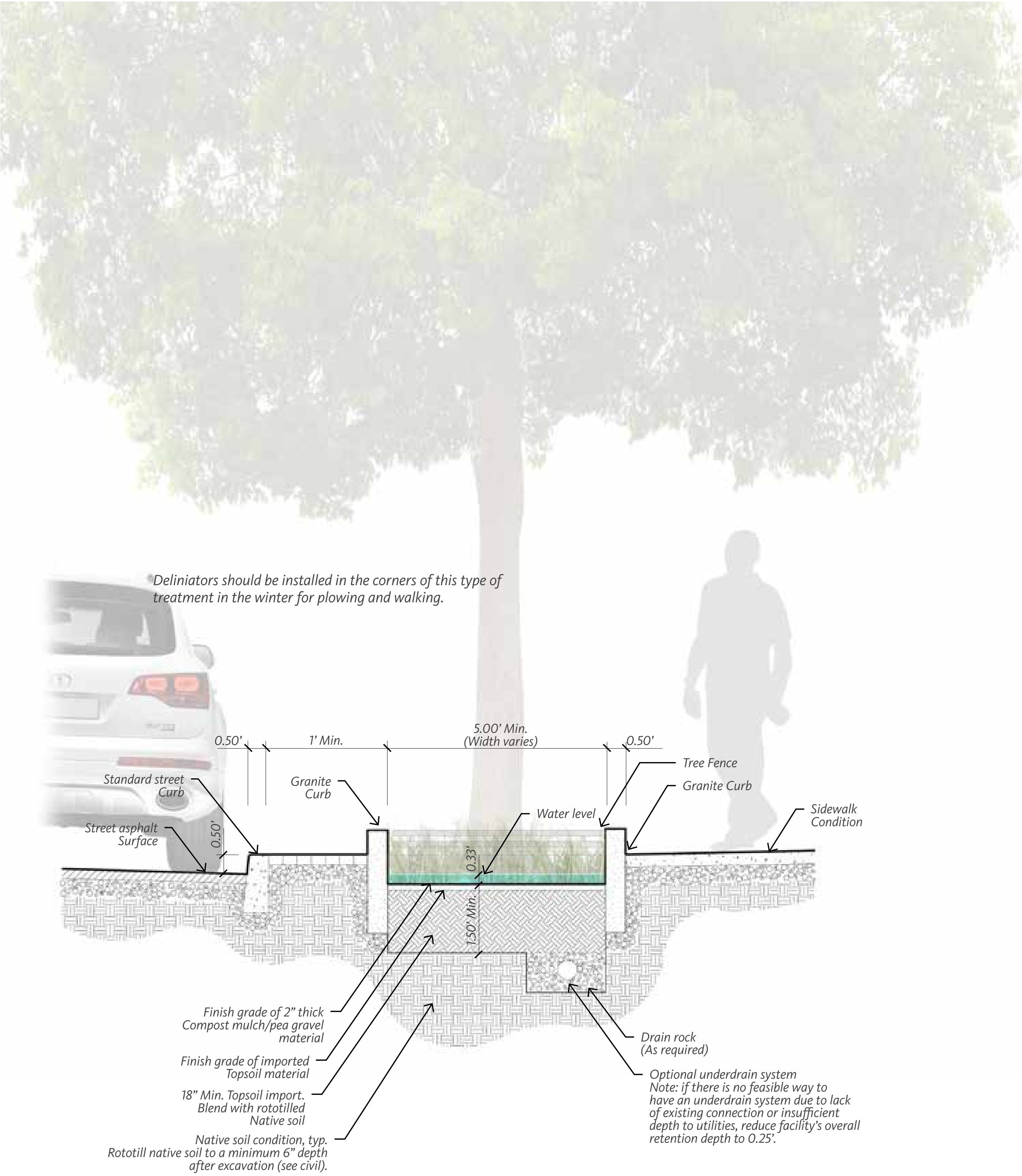
Reference Drawings

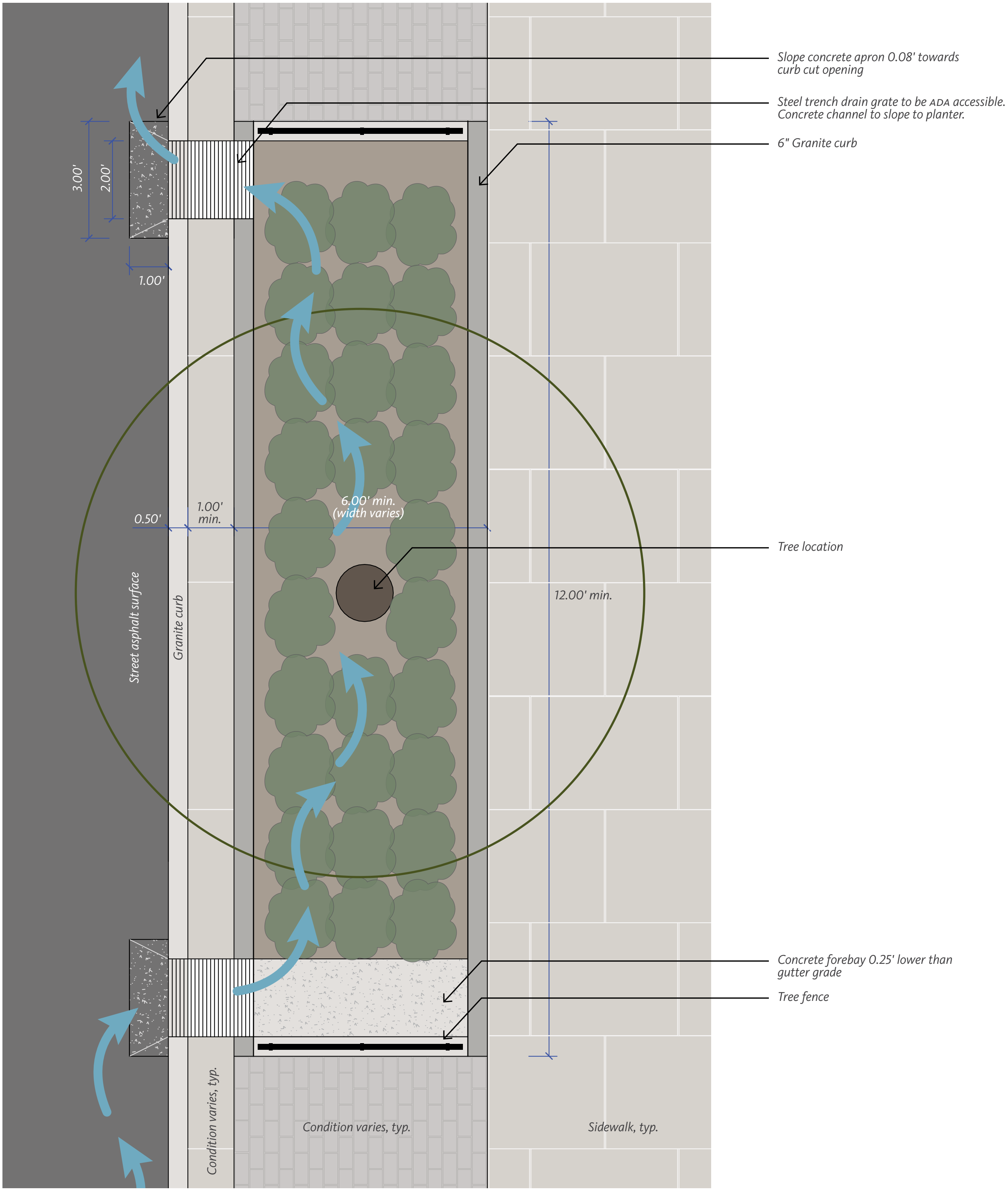
See ref. dwg. **SW–05A & B Street Stormwater Planter (No On-Street Parking)** in *Appendix section A-6*.

See ref. dwg. **SW–06A & B Street Stormwater Planter (With On-Street Parking)** in *Appendix section A-6*.

See ref. dwg. **SW–07A & B Tree Pit Planter** in *Appendix section A-6*.

Street Stormwater Planter Section (Adjacent to On-Street Parking) PILOT




Slope concrete apron 0.08' towards curb cut opening
Steel trench drain grate to be ADA accessible. Concrete channel to slope to planter.
6" Granite curb
3.00'
2.00'
1.00'
0.50'
1.00' min.
6.00' min. (width varies)
Tree location
12.00' min.
Street asphalt surface
Granite curb
Concrete forebay 0.25' lower than gutter grade
Tree fence
Condition varies, typ.
Condition varies, typ.
Sidewalk, typ.

VEGETATED SWALES

Vegetated swales are long, narrow landscaped depressions, with defined 4:1 side slopes to transition grade from sidewalk and street surfaces. They are primarily used to convey stormwater runoff and provide water quality treatment, however, they can also be used to infiltrate stormwater runoff using check dams and weirs to control ponding depth. Residential and arterial street conditions that have a long, continuous, an uninterrupted space to support a functioning landscape system are excellent candidate sites for vegetated swales. The recommended improvements to the tree belt type indicate several corridors with a residential street type, where there are no existing street trees or on-street parking. These conditions are very promising to retrofit these areas with vegetated swales.

Vegetated swales are relatively low-cost, simple to construct, and widely accepted as a stormwater management strategy. Vegetated swales can be planted in a diverse plant palette of grasses, sedges, rushes, shrubs, groundcovers and trees.

Key Design Considerations

Dimensional Requirements
4' minimum cross section width. Minimum length to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and the ability to fit the stormwater planter system between site conditions.

Stormwater Entry
Ideally, stormwater planters can be a curbless application with sheet flow of runoff entering the landscape area. If curbs are required, place 2' minimum width standard curb cuts at the at

An urban arterial vegetated swale retrofit example that accepts runoff through street-side curb cuts.

A vegetated swale incorporated with a bike lane.

A residential vegetated swale on one side of the street.

A residential vegetated swale along a steep street condition.

regular frequencies to allow runoff to enter the stormwater planters. Surface grading around the curb cuts should freely direct water through the curb cut.

Sediment Forebay
If sheet flow is used, no sediment forebay is required. If curb cuts are used, 3' square flat-bottom concrete forebay pads should be placed immediately downstream of the entry curb cuts 2" lower than the street gutter grade to allow for sediment to drop out onto the concrete pad before entering the landscape area. Vegetated can also be placed around the concrete pad to act as a natural dam incent sediment and trash particles to settle in the forebay area.

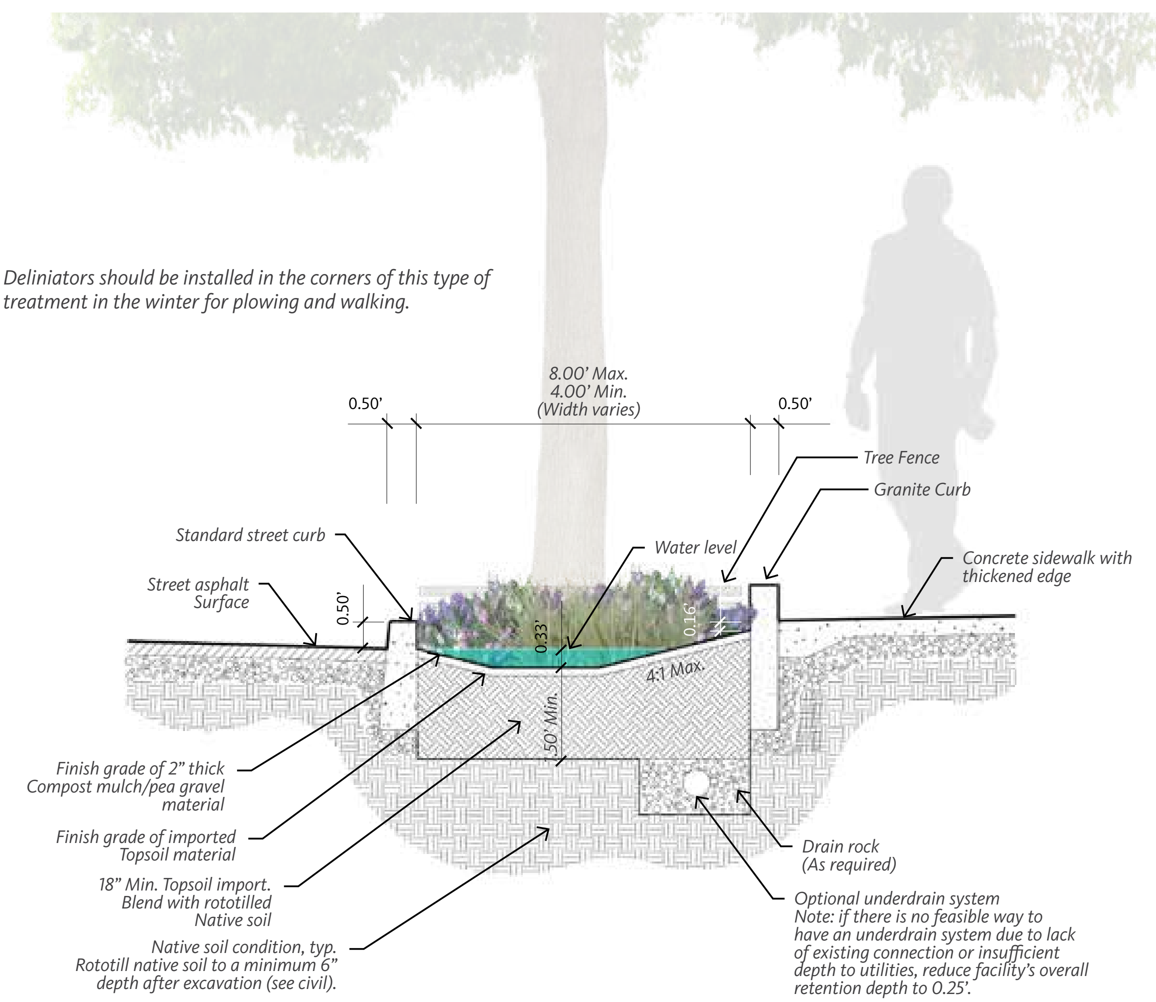
Water Retention Depth
Maximum water retention depth should be 6" of water and can be controlled using check dams and weirs. Green gutters should have check dams installed for street slopes over 2%. For streets slopes over 5%, the interior of the green gutters should be terraced with check dams and act more as a series of planters.

Grading Considerations
The cross section grades in stormwater planters should be flat with a 2" vertical drop in grade stormwater entry points. In some cases where terracing the grade is desirable, creating a flat-bottom grading condition with respect to the street-side curb can be achieved, but care should be taken to not have an overly deep grading condition.

Curbing and Fencing
A curb or fence barrier may be necessary to prevent trash and debris from collecting in these planters, and to ensure pedestrians do not inadvertently step into them. See *"Tree Well Curb & Fence Details" on page 186*.

Reference Drawings
See ref. dwg. **SW–08A & B Vegetated Swale** in *Appendix section A-6*

Vegetated Swale Section



TREE GRATE STORMWATER PLANTERS

In urban downtown areas, such as along Burlington's Main Street, the competition for ground plane landscape space is quite high given the need to maximize usable and unobstructed pedestrian space. However, robust street trees are a vital component to every streetscape to not only provide a comfortable walking condition, but to also capture stormwater runoff. Stormwater planters with street trees can be utilized to capture sidewalk runoff. Installing a metal tree grate between street trees can still accommodate both pedestrian traffic and stormwater management. Tree grates are a common tool in many urban streetscape applications. Unlike typical stormwater planters, tree grate stormwater planters utilize a recessed soil grade to capture, filter, and infiltrate runoff. In some cases, a viable landscape system can also live under the tree grate if the grating gaps allow enough sunlight to reach the vegetation.

Although standard recommendations outlined in this document do not allow street runoff to be captured in tree wells, this system can be implemented under a pilot project condition.

Key Design Considerations

Vehicle Loading Requirements
Tree grate stormwater planter systems need to maintain heavy vehicle (H-20 vehicle loading capability).

Maximum Gap Between Grating
A ½" maximum gap is to be maintained between grating to be ADA compliant, preferably ¼" gap where pedestrians will traverse.

Dimensional Requirements
6' minimum cross section width to support healthy tree soil volumes and tree root growth. Minimum length to be determined by appropriate sizing of contributing stormwater Drainage Management Area (DMA) and the ability to fit the stormwater planter system between site conditions.

Stormwater Entry
Ideally, stormwater planters can be a curbless application with sheet flow of runoff entering the tree grate area.

Sediment Forebay
If sheet flow is used, no sediment forebay is required.

Water Retention Depth
Maximum water retention depth should be 6" of water.

Grading Considerations
The cross section grades in tree grate stormwater planters should be flat with a 6" vertical drop in grade stormwater entry points.

An urban tree belt zone with long, linear tree grates. Image shown may not exactly match specific details of standards proposed in this document. (See p. 307)

A grating system with ¼" gaps that allow enough light penetration to allow sedum to grow beneath the grating. Image shown is for illustrative purposes only. Proposed tree grate gap width will be narrower, per standards. (See p. 307)

Sediment Forebays

DEALING WITH SEDIMENT

In sheet flow situations, sediment and other debris drop out evenly along the length of the stormwater facility. This can reduce the need for frequent removal of sediment from within the facility. However, when curb cuts are used and runoff enters a stormwater facility as concentrated flow, debris will also enter in a concentrated load. The value of using sediment forebays depends highly on how much sediment debris the street typically produces. Some stormwater facilities may not need a sediment forebay at all. Other stormwater facilities, particularly those located on streets that have high traffic loads or substantial leaf drop, would most likely benefit from having a sediment forebay and a regular maintenance schedule to clear debris from it.

Sediment forebays help define a space at the entry of a stormwater facility for sediment and debris to collect and be periodically removed. Providing this space can help reduce maintenance by trapping sediment before it is transported into established landscape areas. The goal of a sediment forebay is to minimize the amount of sediment transported into the landscaped area, not to completely eliminate it.

Ultimately, a sediment forebay should be sized and designed so that it is seamlessly integrated into the landscape area. The design of a sediment forebay can be as simple as leaving a small, shallow-graded, non-planted area right after the entry curb cut. It is recommended that the sediment forebay be paved to minimize erosion and ease the removal of sediment. High density planting located on the downstream side of a sediment forebay can help act as a containment dam for sediment and debris.

A sediment forebay within a stormwater curb extension. (Image source: Nevue Ngan Associates)

A 3 × 3 foot concrete pad is used as a sediment forebay for a large street rain garden. The plant material acts as a dam allowing debris to settle on the pad for regular removal. (Image source: Nevue Ngan Associates)

Check Dams & Weirs

Dealing with Steep Topography

There are many steep slope conditions found along the streets of downtown Burlington that require special design consideration for managing stormwater runoff. Slowing the speed of runoff as it moves downhill helps reduce impacts downstream and mimics natural hydrologic functions. Installing vegetated systems to slow street runoff is the first step, but it may be necessary to also delay the flow of runoff by building structures and terracing the soil grade within these vegetated systems to further slow runoff and incent the water to soak into the ground. These structures are commonly referred to as check dams and weirs. Building terraced stormwater planters and swales help flatten the interior slopes of landscape areas compared to the steepness of a street. Closely-spaced check dams and weirs can then help slow down the flow of water, mimicking a more natural condition. Depending on the underlying soil conditions, some of this water might also infiltrate into the native soils. A geotechnical engineer should be consulted during the design process to evaluate and analyze steep areas for susceptibility to landslides.

Using Check Dams and Weirs

Check dams and weirs are the "speed bumps" of stormwater management. They are designed and strategically placed within a stormwater facility to slow the flow of runoff. Check dams are structures in the landscape that retain stormwater. Weirs are a notch within a checkdam with an adjustable height to allow for varied amounts of stormwater retention. Check dams should retain stormwater to relatively shallow depths, with a maximum ponding depth of 6–8 inches of runoff during storm events.

Both check dams and weirs can be made from a variety of construction materials, such as rock, concrete, metal, wood, or any other durable material. The number and spacing of check dams is largely dependent on the stormwater goal of a project and the particular site conditions. For green street and parking lot applications, slopes greater than 2–4% should have a check dam at least every 25 feet. In steeper conditions, checkdams will need to be placed at a greater frequency (sometimes every 8 feet) and may need to be made from the most durable hardscape materials to withstand the forces of the water.

Check dams may also be placed within swales and planters that have little or no longitudinal slope in order to promote infiltration. This should be done only where soil conditions are conducive to infiltration (Class A or B soils) or where there is an underdrain system installed in the stormwater facility.

(Image source: Nevue Ngan Associates)

A metal weir separates a drop in grade from one stormwater planter to the next. Scuppers along the weir allows for overflow to occur at controlled points.

(Image source: Nevue Ngan Associates)

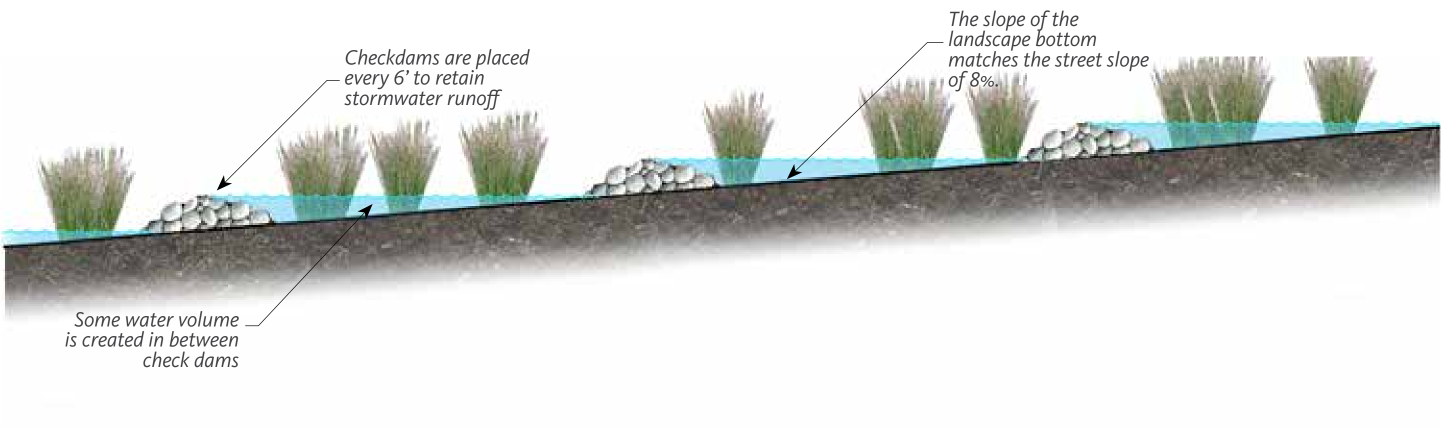
This adjustable weir can control how much water is to be retained within a rain garden.

(Image source: Kevin Robert Perry—City of Portland)

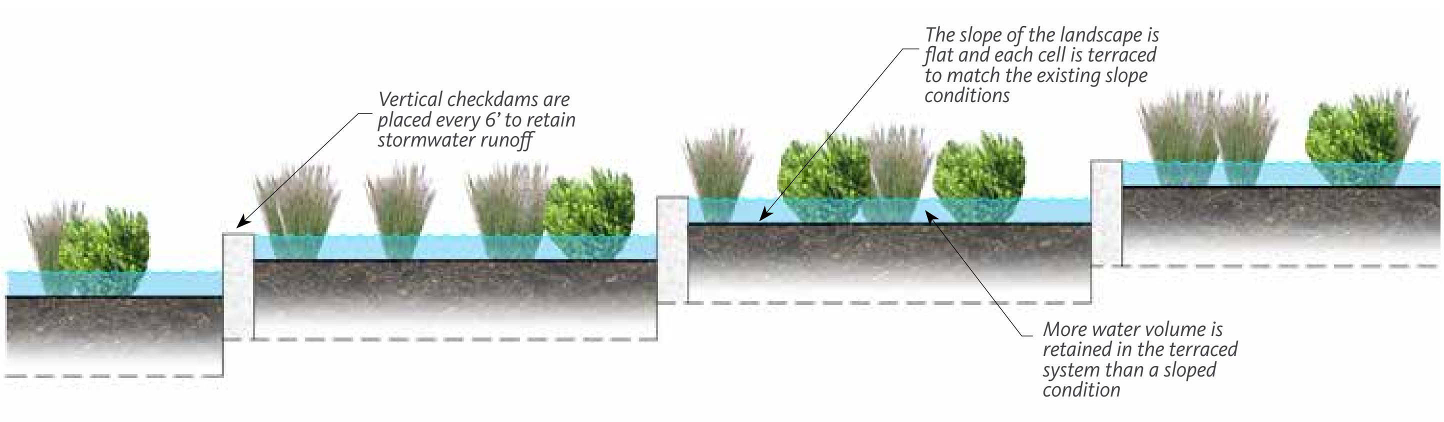
Simple checkdams made of stacked rocks or gravel can be used on gently sloped stormwater facilities.

A series of wood and concrete checkdams allows for a terracing in grade along a green street project. These checkdams are placed 6 feet on-center to accommodate the street's 7% grade.

Simple Rock Check Dam Example



Terraced Grade and Vertical Check Dam Example



Capturing Street Runoff

Curb Cuts & Sheet Flows

One of the primary considerations for designing stormwater facilities associated with streets and parking lots is determining how the runoff enters a stormwater facility. There are two primary ways that runoff is directed into stormwater facilities-sheet flow and curb cuts. Sheet flow describes stormwater runoff that enters a stormwater facility evenly distributed on the pavement surface without concentrating flow. Curb cuts allow stormwater to enter a stormwater facility at specific points along a raised curb, thus concentrating runoff both in velocity and volume.

Of the two methods, sheet flow is by far the better design because it mimics the natural flow of water across the landscape, employs a less complicated design, and is less prone to failure. Sheet flow, or "curbless" streets and parking lots, typically employ a concrete band edging that is flush with the stormwater facility and the street/parking lot surface. Having this concrete band provides a clean edge along the more malleable asphalt surface. In addition, the concrete band is easier to fine grade than asphalt in order to direct water into the stormwater facility. Curbless streets do have their concerns, especially during Vermont's winter conditions, because it may be difficult to determine where the street ends and landscape begins when there is prolonged snow accumulation.

Curb cuts along a raised curb system are commonly used to allow water to flow into stormwater facilities, This approach channelizes water flow and can be prone to failure if the curb cut design is poor and/or there is a build up of sediment or debris at the curb cut. If curb cuts are used, they should be carefully designed. Curb cuts should be spaced frequently along the length of the curb to distribute the water flow as evenly as possible within the stormwater facility.

The decision to have curbed or uncurbed streets is typically based on the anticipated type and intensity of vehicular and pedestrian use. In general, the higher the traffic speed and less pedestrian-oriented the street is, the more likely a raised curbed street edge will be required. Conversely, streets that have slower traffic speeds and are more pedestrian-friendly are good candidates for a curbless condition. Even commercial streets with on-street parking can be designed as curbless streets if there is enough right-of-way space and traffic speeds are relatively low.

Curb cuts along stormwater facilities should be as wide as possible to accept flow from along the street or parking lot edge. A flaw in curb cut design is to try to "cover" or create a notched curb cut. These designs often fail because the opening for stormwater runoff is restricted and results in trapped sediment and debris. When a notched curb cut is plugged with debris, it often goes unnoticed. It is recommended that an 24 inch minimum width "open" curb cut be used at entrances to stormwater facilities. On steeper streets, it is a good idea to build a small, low-profile asphalt or concrete berm at each curb cut inlet to guide stormwater flow into the stormwater facility. Without such a measure, runoff can sometimes flow past the curb cut and bypass the stormwater facility during intense storm events. Grated curb cuts, also called trench drains, are often used in street applications to allow water to flow underneath sidewalks. Trench drains for green streets need special design attention and maintenance to assure water will flow into the stormwater facility. Also, grates need to be slip resistant and American Disability Act (ADA) compliant.

Both sheet flow and curb cut systems need to allow for a minimum 3 inch drop in grade between the street/parking lot grade and the finish grade of the stormwater facility. This drop in grade assures that water will freely enter the landscape space even if there is some sediment accumulation.

Catch Basins

Catch basins are subsurface structures that capture stormwater from streets and parking lots through inlet grates. Catch basins are generally installed in a piped stormwater conveyance system and can be used as a pretreatment practice to remove coarse sediment, trash, and debris. They can also serve as temporary spill containment devices for floatables such as oils and greases.

Catch basins that are to be used as a pretreatment practice (i.e. deep sump catch basin) should be isolated from the conveyance system (off-line), having only an outlet pipe which connects to a downstream structure or manhole. The structure should not have any inlet pipes from other structures. A deep sump catch basin should also have a minimum depth of 4 feet below the lowest pipe invert, or four times the diameter of the outlet pipe, whichever is greater.

Catch basin geometry should have sufficient access for inspection and maintenance purposes. Catch basins spacing should not exceed 250 feet and have a drainage area that does not exceed 0.25 acres of impervious area, such as pavement or concrete. They should also be sized to handle flows from 10-year, 24-hour storm event, without interfering with the inlet; and have a maximum depth of flow of 0.35 feet to the catch basin.

Inlet grates to catch basins should be chosen on a case-by-case basis. Considerations that will determine the type of grate necessary for a given catch basin are location, pedestrians or

A standard curb cut allows stormwater runoff to enter a parking lot rain garden. This curb cut has 45 degree chamfered sides. (Image source: Nevue Ngan Associates)

A grated curb cut allows stormwater to pass under a pedestrian egress zone to the stormwater facility. (Image source: Kevin Robert Perry—City of Portland)

This curb cut with side wings retains the side slope soil grade within a rain garden project.

Grated curb cuts conveying street runoff should be at least 18 inches wide, preferably 24 inches wide to adequate handle stormwater flow. (Image source: Nevue Ngan Associates)

This curb cut entry at a stormwater curb extension allows water to enter the landscape along the street's gutter line.

This flush concrete curb allows for even sheet flow to enter a green gutter system. There is about a 3" grade difference between the curb and soil grade.

handicapped traffic, and bicycle traffic. Depending on the terrain at a given location, whether a hilly or flat street, or a parking lot, the hydraulic efficiency of the grate to capture stormwater will be a significant factor. The main considerations for specifying inlet grates are the geometry and the flow-through area of the openings for each individual grate. Additionally, increasing pedestrian and bicycle traffic means that the safety of an inlet grate has become just as important as hydraulic efficiency. Inlet grates may need to be ADA compliant.

The utilization of catch basins will be based on horizontal and vertical site constraints such as existing or proposed utilities, depth to bedrock, or depth to groundwater. Also, the use of debris hoods will require design considerations for cleaning and maintenance of the catch basin.

Catch basins should be located uphill of a curb ramp in order to avoid puddling and freezing in the flattest part of the ramp.

Detention

Underground stormwater retention/detention systems are typically used to store stormwater for a storm sewer conveyance system. Stormwater is detained in an adjacent structure, then discharged at a rate that will not inundate the conveyance system on the downstream end. Alternatively, by using perforated structures installed in a gravel bedding, stormwater detention systems can be used to infiltrate stormwater into surrounding soils, acting as a stormwater treatment practice. Typically, stormwater detention and infiltration systems can be designed for many different shapes, sizes, and materials necessary to meet project needs.

Stormwater detention systems are generally used in new development areas where land availability is limited or there are significant land costs. By using an underground detention system, it could provide an efficient use of the land available and help to reduce cost. These systems can be installed quickly and can be constructed from concrete, steel, or plastic materials; each having advantages and disadvantages. The material type will be dependent on the project requirements.

When designing an underground detention system for infiltration, the main considerations are the soil types and depth of the water table. It is recommended that underground infiltration systems be used in areas with well-drained soils that are conducive to infiltration; and where the water table depth is low enough to allow for groundwater recharge. Generally, the installation of pretreatment practices is recommended to remove sediment and debris that could obstruct perforations. Pretreatment practices could include, but are not limited to, deep sump catch basins, sediment traps, or sand filters.

Subsurface detention systems can provide peak flow control and temporarily store stormwater to be released at a calculated rate. These systems are not typically designed to enhance water quality, however, when combined with other stormwater BMPs, project goals may be met.

Subsurface retention/detention systems have several advantages, including but not limited to: capture and store runoff to reduce post-development peak flows; these systems are better for urbanized areas with space constraints; relatively fast installation time; these systems are estimated last several decades; systems are typically safer with few impacts on aesthetics. Subsurface retention/detention systems also have some disadvantages such as additional excavation is typically required; not primarily designed for water quality enhancement; without proper pre-treatment, infiltration from a retention system may contribute to groundwater contamination; and maintenance and cleaning is more difficult than aboveground systems.

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6 Lighting

Street Lights

Street Lights

Street lights provide general illumination for all street users. However, due to the expense of light fixtures and associated infrastructure, most street lighting is utilitarian in nature, with luminaries mounted high on the pole in a way that achieves more coverage per light (i.e., at 20 feet or higher), and lights are typically scaled and oriented to the Roadway Zone. This approach accomplishes the task of lighting the street with fewer fixtures, but does not contribute to an overall urban design that supports a pedestrian scale and comfort of the non-driving street users.

Appropriate street lighting facilitates safe movement of traffic and provides a sense of safety and security for pedestrians. When used effectively, lighting can do much more. Good streetscape lighting lends character to a street, and by highlighting salient features, can provide a sense of place and civic pride. Downtown street lighting should complement the context and land use of the street, as well as account for existing lighting levels, nighttime design compositions, and aesthetics.

The goal of these street lighting recommendations is to provide safe, even lighting while reducing energy consumption and costs, light trespass (unwanted light), and dark sky pollution. These standards recommend only the use of LEDs, which require less energy and maintenance and are designed to minimize light trespass and light pollution. LEDs can also enhance visibility, with better color rendering (i.e., colors appear more natural) and a more even spread of light, eliminating the unintended over lighting of a street.

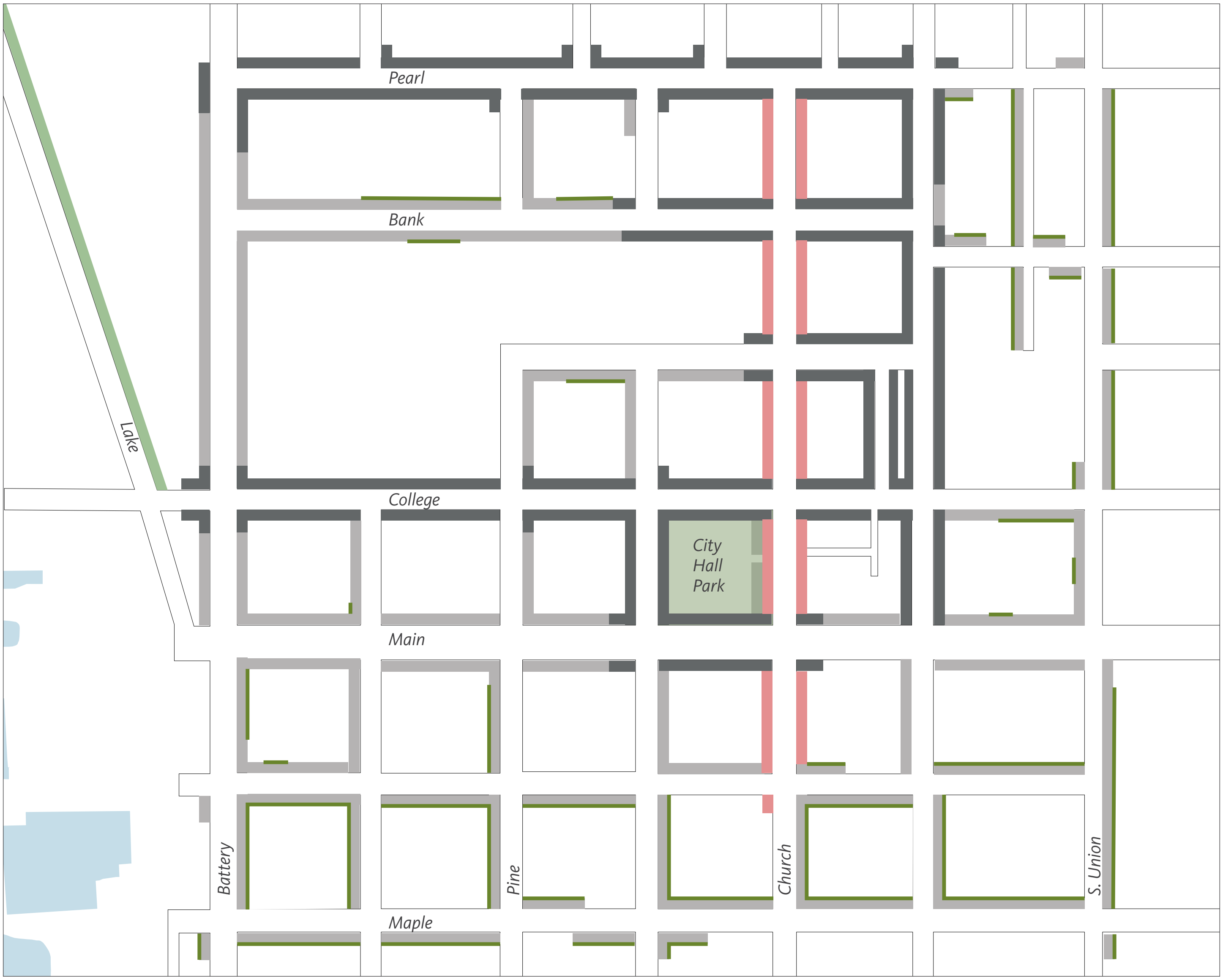
Street lights should:

- Facilitate safe movement of pedestrians, bicyclists, and motor vehicles
- Create an environment that feels safe and secure for pedestrians
- Improve the legibility of streets, intersections, ramps, transit stops, critical nodes, and activity zones
- Reveal squares, public spaces, and special districts to encourage nighttime use
- Enhance the character of the streetscape by using fixtures that are in keeping with the image of the City and the unique look of specially designated districts
- Use state-of-the art technology when appropriate to provide effective, energy efficient lighting that minimizes light trespass and is dark sky compliant

Criteria and Considerations

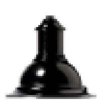
- Utilize a paired alignment of light poles across a street, which provides a formal look that reinforces the direction of travel.
- As LED technology develops, future consideration should be given to providing network control to allow for color control as a way to highlight locations during emergencies.

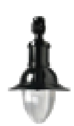
Existing Lighting—Pole & Luminaire Type



A detailed map of each of these assemblies and images of the lighting fixtures can be found in *"Street Lighting" on page 27.*

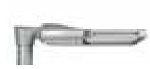
Metal Pole


Domus 50


Philips Renaissance


Lake St. Fixture

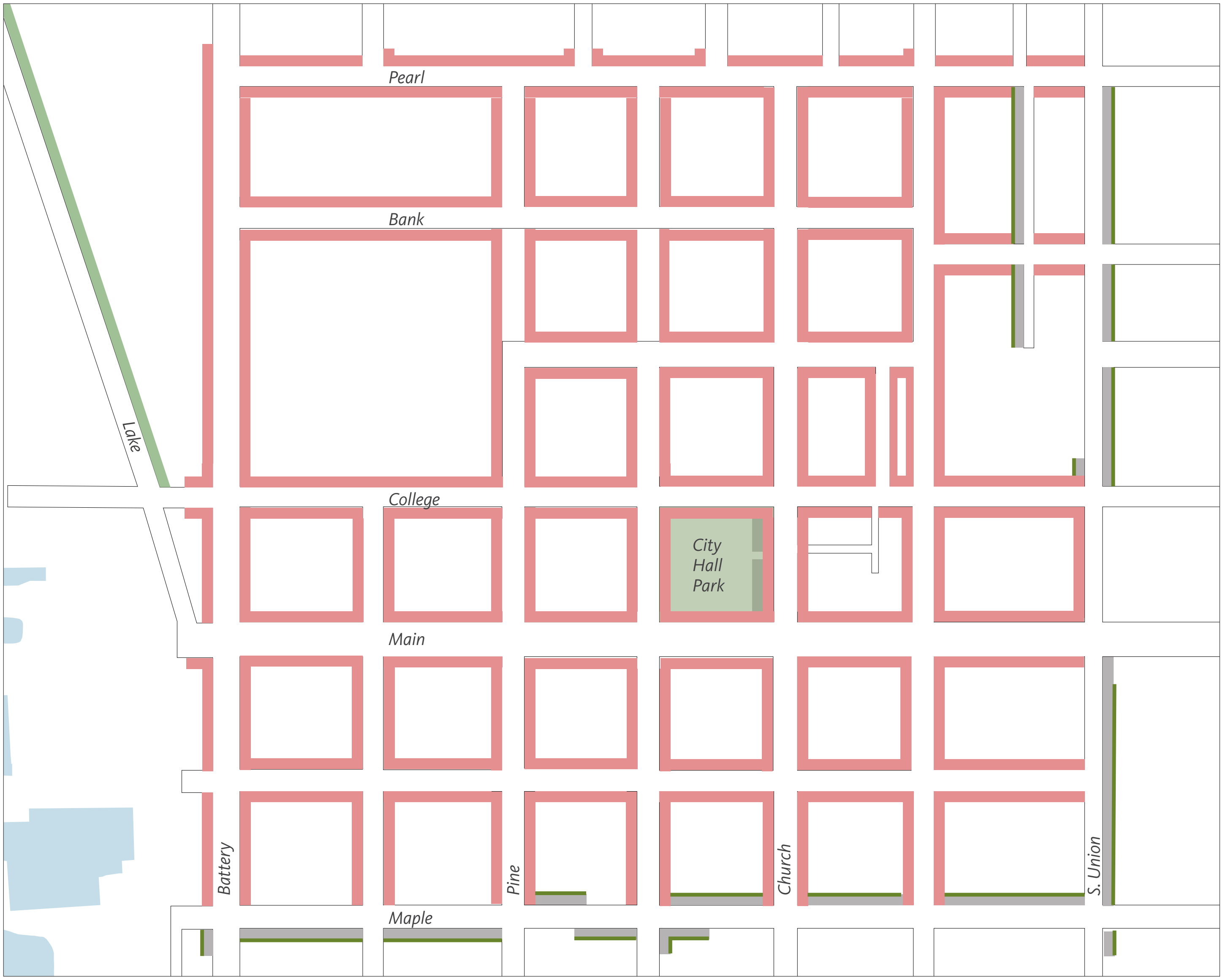
Wood or Fiberglass Pole


Cobra Head LED

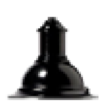

Cobra Head HPS

Overhead Power

Proposed Lighting—Pole & Luminaire Type



Metal Pole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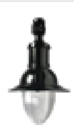
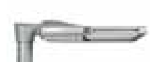

Philips Renaissance


Lake St. Fixture

Wood or Fiberglass Pole


Cobra Head LED


Cobra Head HPS

Overhead Power

Lighting Strategy for Great Streets

The following fixtures and strategies are recommended for downtown Burlington's Decorative Lighting District in order to meet the street lighting goals articulated in this section.

STANDARD LIGHTING ASSEMBLY

The Great Streets lighting recommendations utilize a combination of elements from the existing standards for downtown's decorative lighting district and the Park's standards, reconfiguring them into a new standard lighting assembly. See the diagram on *page 251*.

Pole: A new 5" dia. straight steel pole. See *"Pole" on page 263.*

Base: Utilize Parks Department standard base style, in a 2-piece clamshell model. The 2-piece clamshell base allows for easy replacement without needing to disturb/remove other elements on the pole. Compared to other elements on the pole, the base is the most susceptible to corrosion/damage from salt, plows/cars, and dogs relieving themselves against the pole. For these reasons the base should be viewed as sacrificial and an element that can be replaced as necessary. See *"Base" on page 263.*

Base Material:
- Fiberglass/Fiberglass composite urethane (preferred as it is lightweight and durable)
- Cast Iron (optional)
- Cast aluminum (optional)

Arm: Utilize standard nominal 4' long straight arm. Single or double arm assembly depending on width of ROW and lighting criteria. See *"Arms/Brackets" on page 264.*

Luminaire: Utilize BED standard Philips Renaissance—teardrop luminaire with skirt.

Luminare Mounting Height: 18' AFG (15' minimum above finished street surface)

Color Temperature: 3000 K (warmer white)

Distribution: Luminaire shall be Type IV distribution, and 0–10V dimmable.

Wattage: 24–55 depending on layout type. *"Pole Layout & Spacing" on page 252.*

Finish for all pole elements and luminaire: Powder coat—River Texture Black

Features at selected light poles:
- Provide weatherproof, light sensing receptacle on the pole (10' AFG) to allow for seasonal lighting on the pole.
- Provide arms and straps for mounting banners and seasonal decorations (bottom arm 8' AFG).
- These features may be included on all light poles throughout the decorative district, but should be prioritized on streets that make up the pinwheel. See *"Reframing the "Center" of Downtown" on page 8.*

Banners: Provide arms and straps for mounting banners and seasonal decorations (bottom arm 8' AFG). Light poles should be able to withstand 90–100 MPH winds with a 1.3 gust factor. Any appendages to the pole such as banners need to be factored into the wind loading calculations performed by the structural engineer or pole manufacturer. See *"Banner Arm & Bracket" on page 266.*

Implementation: The City's Municipal Development Plan recommends that lighting assemblies should be upgraded to decorative poles and fixtures when a lighting system has been placed underground; however, there is not a long-term plan to do so Citywide. Furthermore, BED Street Lighting Policy indicates that the increased cost for equipment and maintenance associated with decorative fixtures and banners must be paid in advance by the City. Undergrounding and upgrading lighting systems is incredibly costly, and until significant reconstruction of some or all of these streets occurs, it is likely that existing lighting assemblies and aerial utility systems are likely to remain in place for some time. For these scenarios, two recommendations are provided:

- In conditions where there are existing utility poles with high pressure sodium cobraheads that will remain in-place, the cobrahead shall be replaced with BED's LED standard cobrahead as in interim condition. When the new light pole standard and spacing is implemented, the existing luminaires on the utility poles shall be removed.
- BED may work with manufacturers of the City's decorative lighting elements to explore whether a retrofit may be available to enable decorative arms and fixtures to be used on wooden poles where aerial utilities still exist.

There are many streets which have recently been upgraded to the existing decorative standard for downtown—including a custom arm and Domus fixture. It is not recommended that these street lights be replaced immediately. Instead, the recommended assembly should be implemented in the following way:

- Gateway Streets should be the first priority, especially when a street is to be reconstructed.
- When a significant street redesign/reconstruction takes place, or when a significant private development is taking place on adjacent private property within the Downtown or Waterfront TIF Districts.
- As other existing assemblies and fixtures reach the end of their useful life.

Existing Elements

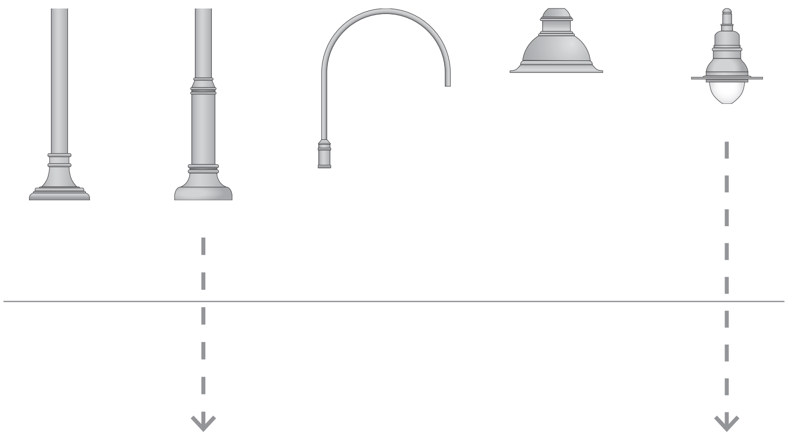
Philips Pole & Base (BED)

AAL DB6 Base with 4" Pole (Parks)

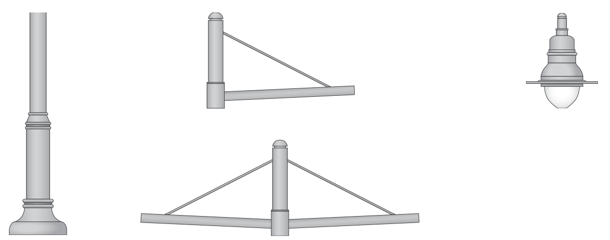
Custom "Gooseneck" (BED)

Philips "Domus" (BED)

Philips "Renaissance" (Church St.)



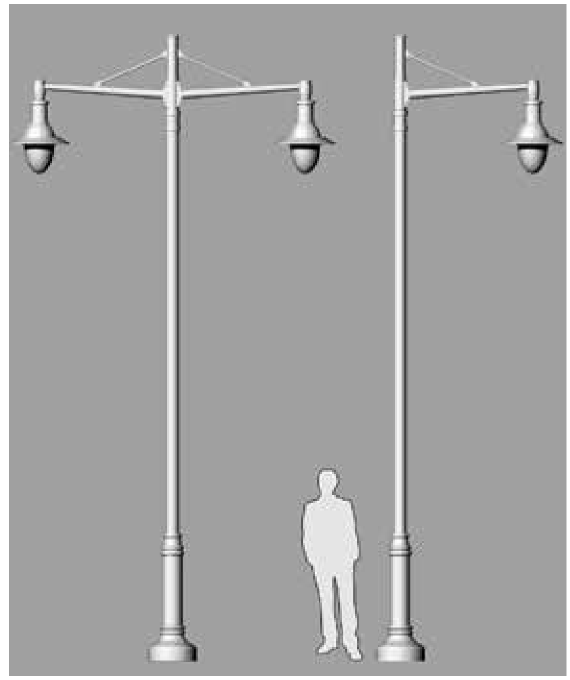
Proposed Elements



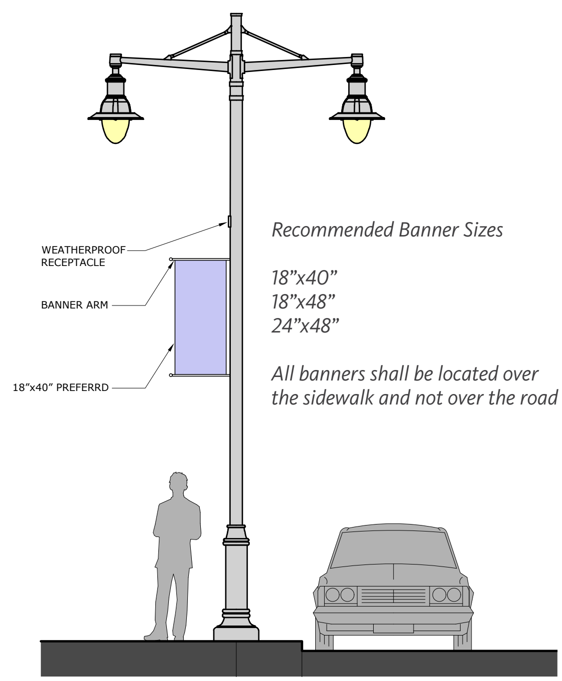
AAL DB10 Base with 5" Pole

Philips Lumec Arms PC4 (single) PC4-2 (double)

Philips "Renaissance"



Recommended Great Streets lighting assemblies, single and double arm configuration options based on street width and lighting criteria.



Recommended Banner Sizes

18"x40"
18"x48"
24"x48"

All banners shall be located over the sidewalk and not over the road

Pole recommendation

POLE LAYOUT & SPACING

Layout

Light poles should be oriented in a soldier (opposite) pattern, which lends itself to a "boulevard" effect, with a light pole landing on each corner of an intersection.

Spacing

See corresponding pole and arm assembly diagrams at right, and the typical pole layout digram for example spacing and classification on the following page. For general guidelines regarding the location of street light poles relative to other elements within the public ROW, see *"Element Siting & Considerations" on page 112*.

Type A

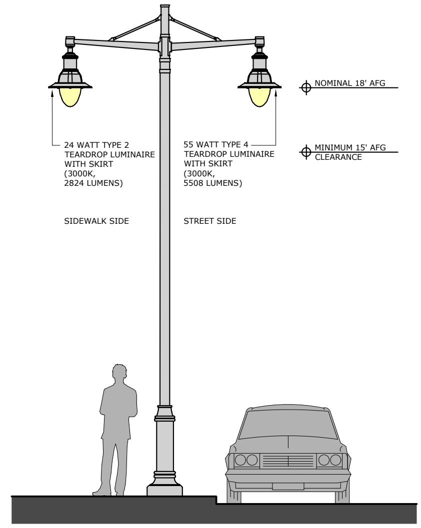
- Recommended for use on streets with 18' or wider Pedestrian Zones, and on streets that meet the IESNA recommended thresholds for "Major" streets with "High" pedestrian conflict.
- Double arm/luminaire
- Pole-to-Pole Spacing: 95' preferred
- Setback from Curb: 2'-6" preferred
- 24-watt luminaire sidewalk side; 55-watt luminaire street side

Type B

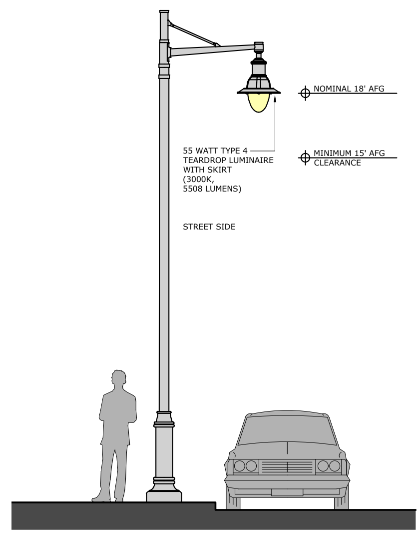
- Recommended for use on streets with less than 18' Pedestrian Zones, and on streets that meet the IESNA recommended thresholds for "Major" or "Collector" streets with "Medium" pedestrian conflict.
- Single arm/luminaire
- Pole-to-Pole Spacing: 85' preferred
- Setback from Curb: 2'-6" preferred
- 55-watt luminaire street side

Type C

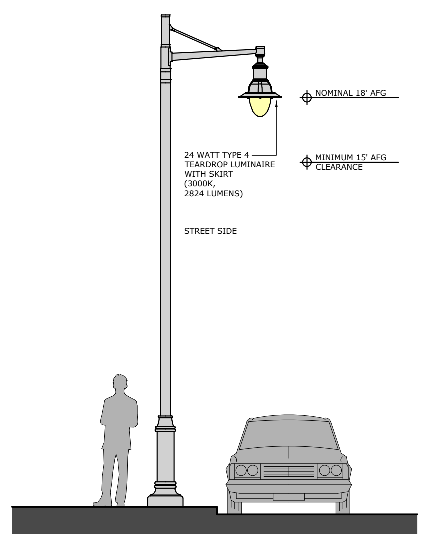
- Recommended for use on Minimum Commercial and Downtown Residential Street Types, and on streets that meet the IESNA recommended thresholds for "Local" streets with "Low" pedestrian conflict.
- Single arm/luminaire
- Pole-to-Pole Spacing: 80' preferred
- Setback from Curb: 2'-6" preferred
- 24-watt luminaire street side



Type A

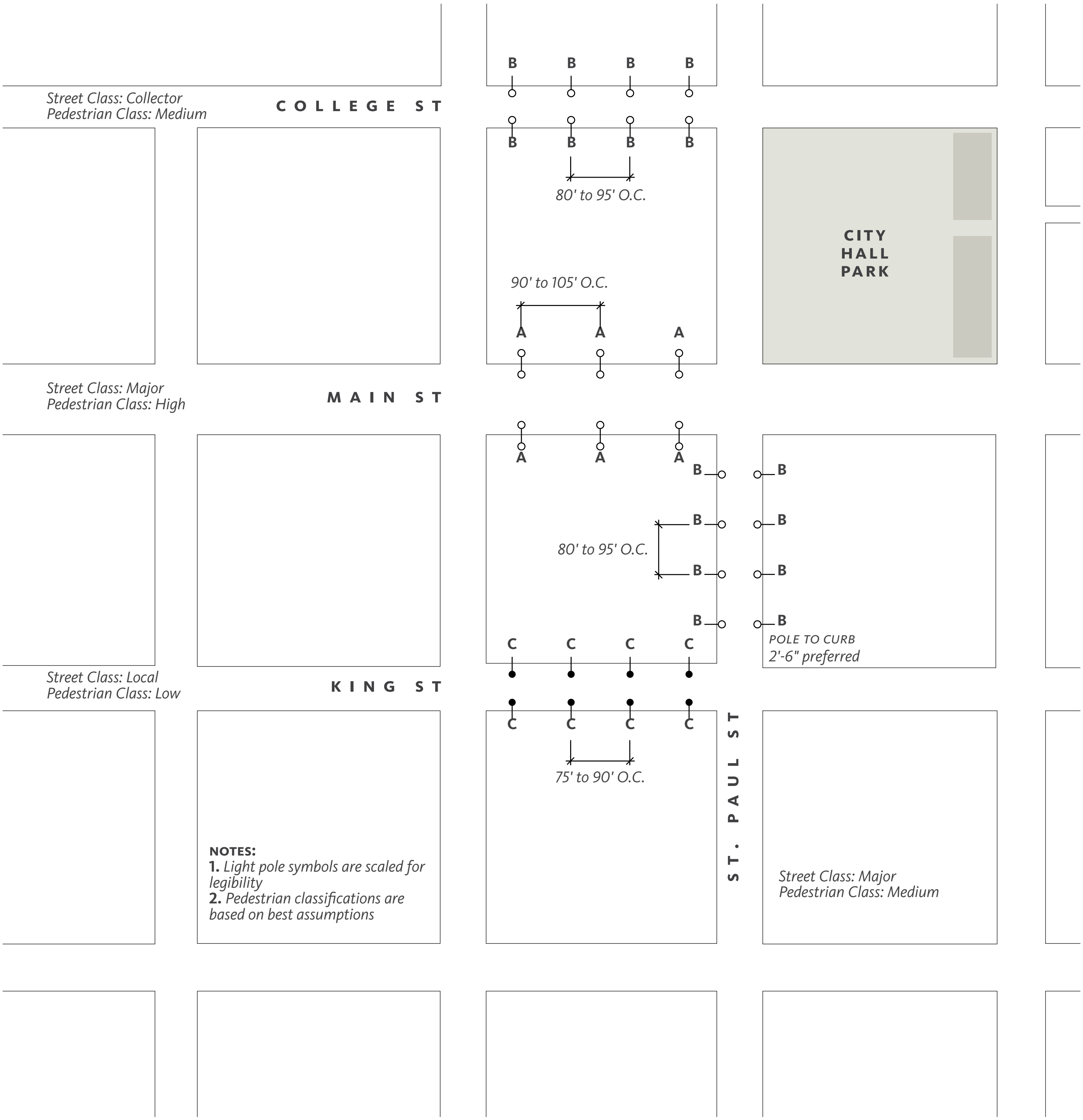


Type B



Type C

Typical Pole Layout

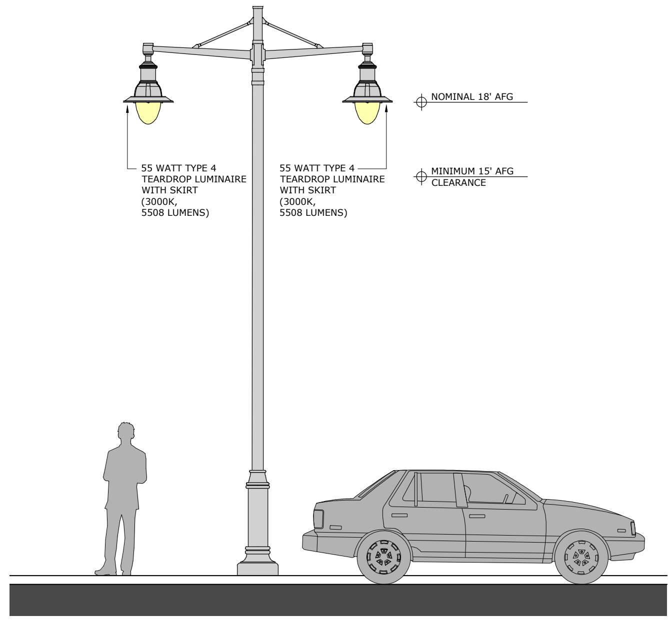


Preferred pole layout and spacing on streets with various dimensions and classifications per the IESNA recommendations. See details on page 232 for the classification of all streets in the Great Streets standards area. Actual layout may vary slightly due to unique street considerations.

Lighting at Mid-Block Crossings & Intersections

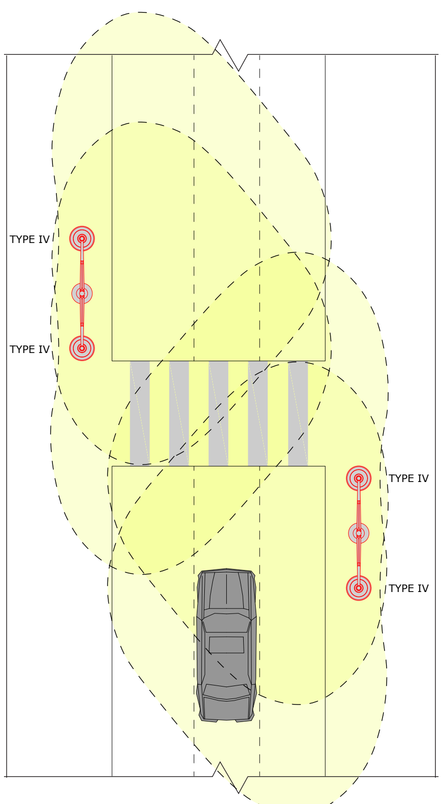
Type D

- Recommended for use on mid-block crossings and intersections.
- Double arm/luminaire, rotated 90 degrees from standard layout, as to be parallel with curb.
- Mid-Block Crossing: staggered placement on opposite sides of crosswalk.
- Setback from Curb: 2'-6" preferred
- 55-watt luminaire, with standard 90 degree adaptor per spec on *page 265.*

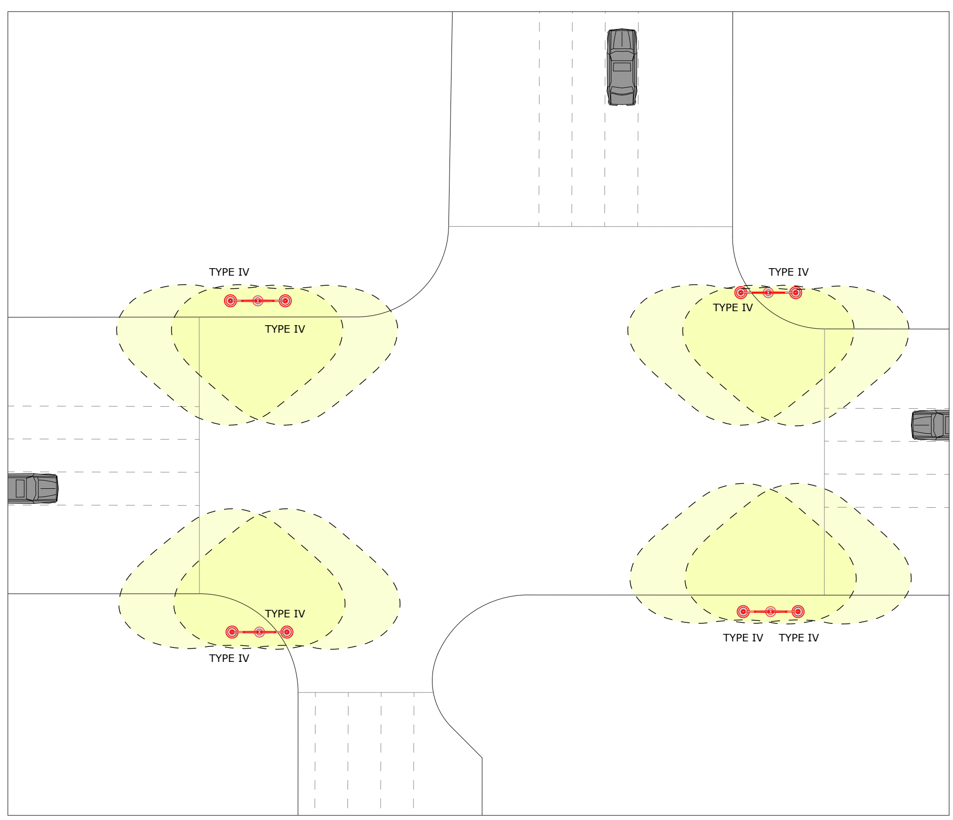


Type D pole configuration for mid-block crossings and intersections

Lighting at Mid-Block Crossings



Lighting at Intersections



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Lighting Criteria

A critical component of any family of lighting design recommendations is the identification of appropriate lighting performance criteria.

It's important to note the difference between light level (illuminance, or light falling on a surface) and luminance (which can be simply defined as light reflected from a surface or seen directly, as when viewing a luminaire). Per IES-8-2014, horizontal illuminance may be used for the design along curved sections and streets where luminance can be hard to calculate.

Illuminance levels can be expressed in a range, with the low value as the minimum light level recommended for a given area. It is critical to avoid excessive illuminance, as this can impact the comfort and legibility of streets.

Uniformity is typically expressed by means of a maximum- or average-to-minimum light level ratio, in order to reduce contrast and mitigate areas of excessive illuminance and to avoid areas of excessive darkness.

References

Lighting recommendations in this chapter are made in accordance with the following references:

- IESNA RP-8 (2014 and 2000 versions) Roadway Lighting
- IESNA RP-33-14, Lighting for Exterior Environments
- IESNA Lighting Handbook 10th edition
- Burlington Electric Department (BED) Street Lighting Policy
- International Dark-Sky Association Model Lighting Ordinance
- Burlington Electric Department (BED) standard light poles/fixtures
- Burlington Parks Department (BPRW) standard light poles/fixtures

Roadways

Street Classification	Pedestrian Conflict	IESNA RP-08-2014/2000 [Roadway Lighting] IES rec. Avg. Luminance (cd/sq.m)	IES rec. Avg. Illuminance (fc)	DGA recommended Avg. Illuminance (fc)	Uniformity ratio
Major	High	1.2 cd/sq.m	1.7 fc	1.7 - 2.1 fc	3:1
	Medium	0.9 cd/sq.m	1.3 fc	1.3 - 1.6 fc	3:1
	Low	0.6 cd/sq.m	0.9 fc	0.9 - 1.1 fc	3.5:1
Collector	High	0.8 cd/sq.m	1.2 fc	1.2 - 1.5 fc	3:1
	Medium	0.6 cd/sq.m	0.9 fc	0.9 - 1.1 fc	3:1
	Low	0.4 cd/sq.m	0.6 fc	0.6 - 0.8 fc	3.5:1
Local	High	0.6 cd/sq.m	0.9 fc	0.9 - 1.1 fc	3:1
	Medium	0.5 cd/sq.m	0.7 fc	0.7 - 0.9 fc	3:1
	Low	0.3 cd/sq.m	0.4 fc	0.4 - 0.5 fc	3.5:1

Intersections

Pedestrian Classification	Major/ Major	Major/ Collector	Major/ Local	Collector/ Collector	Collector/ Local	Local/ Local
High	3.4 fc	2.9 fc	2.6 fc	2.4 fc	2.1 fc	1.8 fc
Medium	2.6 fc	2.2 fc	2. fc	1.8 fc	1.6 fc	1.4 fc
Low	1.8 fc	1.5 fc	1.3 fc	1.2 fc	1.0 fc	0.8 fc

Pedestrian areas and Bikeways

Pedestrian walkways	HIGH Vehicle + Pedestrian	HIGH Pedestrian only	MEDIUM Pedestrian	LOW Pedestrian Rural	LOW Pedestrian Low Residential	LOW Pedestrian Med. Residential
E_{avg}	2.0 fc	1.0 fc	0.5 fc	0.2 fc	0.3 fc	0.4 fc
Vertical @ 5' AFG	1.0 fc	0.5 fc	0.2 fc	0.6 fc	0.8 fc	0.1 fc
E_{avg} / E_{min}	4.0:1	4.0:1	4.0:1	10.0:1	6.0:1	4.0:1

IESNA recommended lighting levels for roadways, intersections, and pedestrian and bike ways based on classification and opportunity for conflict.

Figure 6: *Street Classifications for purposes of determining IESNA recommended roadway lighting levels based on street classifications provided by DPW.*

LIGHTING QUALITY

Within areas utilizing decorative lighting, the selection of lighting equipment usually focuses on its daytime appearance; however, lighting quality is about the performance and appropriateness of lighting systems at dusk and at night. These lighting recommendations not only consider the daytime appearance of the assemblies, but also the nighttime enhancement of landscape and architectural elements, the provision of safety and perceived security, the minimization of stray light, color rendition of people and streetscape features, and site context.

A visual hierarchy, created by the apparent brightness, sense of spaciousness, and the lighting equipment itself, provides interest, defines activity, and clarifies circulation. Lighting should be layered to provide appropriate intensity and distribution based on the density and types of users. Consideration of views and vistas, whether intimate or from a distance, is important, as is creating logical transitions from one area to another to ensure uniformity sufficient to maintain perceived security. Points of interest, such as park entrances and significant streetscape features, should be brightly lit during nighttime open hours to advise and guide pedestrians.

Vertical illuminance is particularly important along walkways and bikeways for facial recognition. At kiosks and in comfort stations, vertical illuminance is essential for readability of posted materials and to provide for safety and security.

Safety and security are the most important considerations, as identified by the City's utilization of the IESNA lighting recommendations as BED's lighting standard. People often associate brighter areas with higher degrees of safety, but far more often it is lighting quality, rather than quantity, that determines when and how people feel secure. Good color rendition, appropriate light distribution (uniformity), and adequate vertical illuminance, such that faces can be easily discerned and context defined, contribute significantly to perceived security.

LIGHT SOURCES

Light sources should be evaluated with regard to color rendition, color temperature, lamp life, lamp mortality, efficacy (as expressed in lumens per watt), and commercial availability. From the point of view of visual impact, two important concerns are correlated color temperature (CCT) and color rendering index (CRI). CCT is measured in Kelvin, and is defined as the color appearance of a white LED and indicate the apparent "warmth" or "coolness" of the white light. Typically "warm" white is 2700 K to 3000 K and "cool white" is 4000 K to 6500 K. CRI is a measure of a light source's ability to show colors accurately as compared to a familiar reference source such as incandescent light or daylight. The higher the CRI, the better the color rendering ability. As a point of reference, a 2700 K incandescent light source has a CRI of 100.

In the interest of promoting a positive visual impression of spaces and surfaces, light sources with relatively high CRIs are strongly recommended. With respect to color temperature, light sources with CCTs below 3000 K tend to favor warmer surface colors, while CCTs of 4000 K and above favor a cooler color palette.

Use good color rendering sources that afford a distinctive streetscape identity. All lighting approaches shall be based upon the use of LED. Standardization utilizing the below attributes and technologies are suggested:

- LEDs shall be 3000 K with a minimum CRI of 80, a minimum efficacy of 100 LPW and a minimum module life of 100,000 at 70 percent of light output (L70), with a minimum five-year warranty. Driver to have a minimum 60,000 hour average rated life. LED array and driver to be field-replaceable by the managing entity.
- Correlated Color Temperature (CCT) shall be 3000 K.
- Color Rendering Index (CRI) shall be 80 CRI versus 70 CRI for better color rendering, enabling better visual acuity.
- All LED manufacturers will be required to provide a letter of commitment to maintain LED equivalence (permitting design wattage to drop) for a minimum of ten years.
- TCLP-compliant where applicable
- Dimmable

LUMINAIRE SELECTION & DESIGN PARAMETERS

Of the range of luminaires available to perform any given lighting task, total luminaire efficiency and ease of maintenance should be given a high priority. From a maintenance standpoint, the number of luminaire types should be minimized in order to simplify the inventory of lamps, drivers and accessories. In general, all luminaires should comply with the following criteria:

- All luminaires and their requisite electrical components should be UL listed.
- All lighting equipment should comply with all applicable local and national codes and ordinances including NFPA and ANSI.
- All roadway and pedestrian general area fixtures should adhere to recommended BUG rating for LZ3, and be Type IV distribution. See *Figure 7* and *Figure 8, page 258*.
- All exterior luminaires should have a minimum ingress protection (IP) rating of 65.
- All non-decorative luminaires should be well shielded, and offer reduced brightness at high viewing angles to control unnecessary glare.

- Wherever in reach of the public, fixtures should be vandal resistant.
- Fixtures should offer tool-free access whenever possible.

TECHNIQUES

Locate lighting equipment for maximum effectiveness. The lighting should be designed to provide adequate illuminance on sidewalks, on roads, and at intersections. Uniformity and vertical illuminance—light on faces and vertical surfaces—should be considered and yet be prevented from causing high-angle glare or unwanted upward light.

Lighting can provide for a sense of lit destination, providing for long and intermediate vistas that aid navigation throughout Great Streets. Lighting can also be proposed to encourage positive uses, such as nighttime events or at strategic seating areas. This improvement can be realized in several ways:

- Provide lighting at sidewalks and streets. Light poles should be located strategically to avoid trees and enhance a “boulevard effect.”
- Light artwork, structures, and unique features along streets. Lit storefronts and porches at residences improve vertical illuminance. Once key items throughout Great Streets are lit, these can serve as visual landmarks or destinations, encouraging foot traffic and aiding in way finding.
- Outlets at selected trees such as on Main Street and at City Hall Park can power tree "glitter lighting" for seasonal events.

ADAPTIVE LIGHTING CONTROL (DIMMING) (PILOT)

Lighting control is essential to address daylight contribution and to mind energy usage. At minimum, each light pole should have an integral photocell to automatically energize the fixture at dusk and de-energize at dawn.

As an additional energy saving measure, dimming controls allow for energy savings during periods of inactivity. IES RP-08-14 describes an approach called "Adaptive Lighting" where local jurisdictions can vary street and pedestrian classifications based on differences in vehicle traffic volumes throughout the night. For example, at 1 am, when there is reduced street and foot traffic, the fixtures can dim to a certain percentage instead of running at full output, while still meeting the recommended light levels for the lower street and pedestrian classification.

The advancement of outdoor wireless controls allows for dimming, luminaire status (fixture monitoring), and data collection from a light pole without the need to additional conduit or wiring. See *Figure 9, page 259*.

Luminaires shall be installed that allow for adaptive lighting control technology to be utilized. Adaptive control should be piloted on streets where it is installed to collect data and determine the appropriateness of alternative light levels during identified time periods. Before adaptive lighting control is implemented, BED and DPW must provide an updated street classification for the streets on which adaptive control will be used which identifies the street classification during the hours desired for alternative light levels. This should be based on collection of traffic and pedestrian counts during desired time for alternative light levels. In all instances, safe minimum light levels must be provided for all areas accessible to the public at night.

BUG Rating IES TM-15-11					
	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Backlight Rating					
Greater than 2 mounting heights from property line	B1	B3	B4	B5	B5
1 to less than 2 mounting heights from property line and ideally oriented	B1	B2	B3	B4	B4
0.5 to 1 mounting heights from property line and ideally oriented	B0	B1	B2	B3	B3
Less than 0.5 mounting height to property line and properly oriented	B0	B0	B0	B1	B2
Allowed Uplight Rating					
	U0	U1	U2	U3	U4
Allowed Uplight Rating					
Non-building mounted luminaires	G0	G1	G2	G3	G4

Figure 7: *BUG Rating chart*

Figure 8: *Lighting Distribution Types*

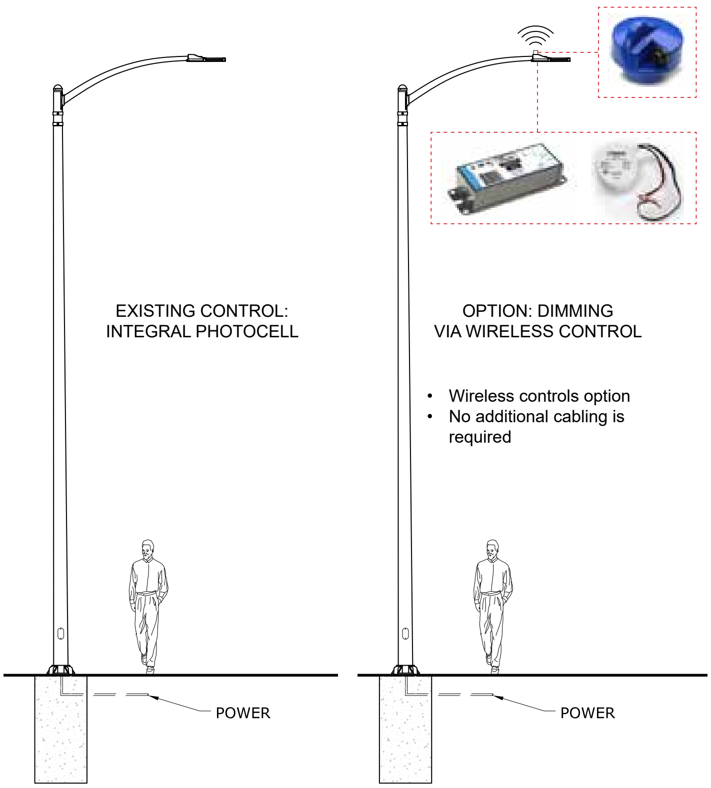


Figure 9: *Lighting Controls*

Lamp Type	Minimum Efficacy (Lumens/ Watt)	Min. Color Rendering Index	Color Temp. (Degree Kelvin)	Lamp Life (Rated Hours)	Comments
HID					
Metal Halide (coated)	80-110	65-85	3200K-3700K ±(1200°K shift)	15,000 - 20,000	Not recommended
Metal Halide (clear)	80-110	65	4000K ±(1200°K shift)	15,000 - 20,000	Not recommended
Metal Halide Pulse Start (Elite)	100-120	85-90	3000K-4300K ±(150°K shift)	15000 - 20,000+	Not recommended
Metal Halide Ceramic	90-93	85-90	3000K-4200K (±75°K shift)	30,000	Not recommended
High Pressure sodium (standard)	100	22	2200K	24,000 40,000	Not recommended
INDUCTION					
ICETRON	80	80	3500K-4100K	100,000	Not recommended
LED					
LED (White)	100-120	80	3000K-4000K	70,000 - 100,000	Recommended

Figure 10: *Lamp Technology comparison chart*

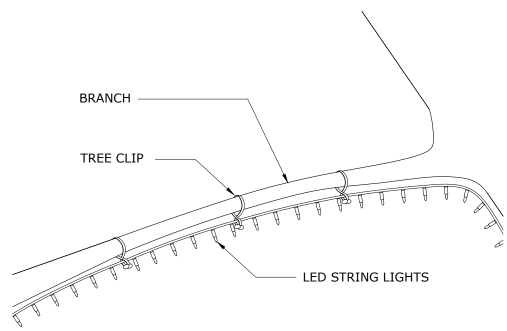
Optional Seasonal Elements

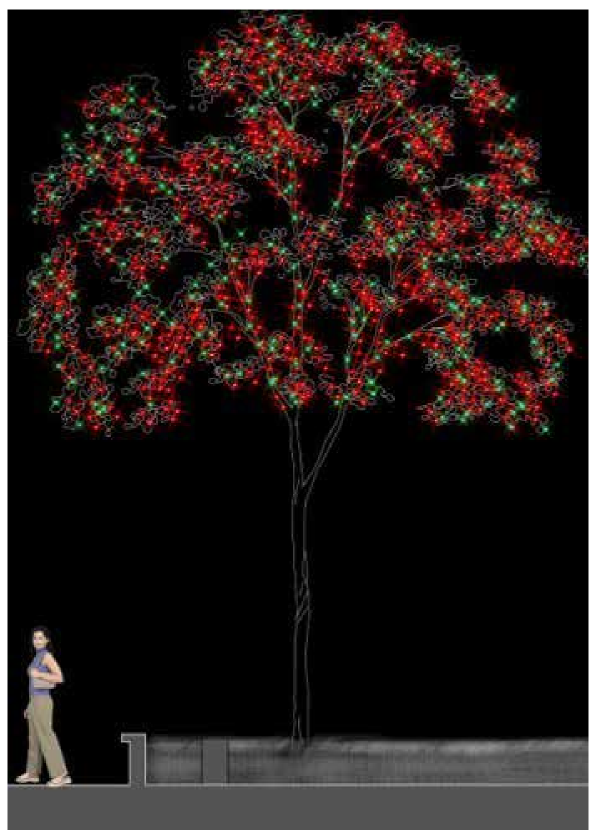
TREE LIGHTING

On selected trees, such as along the streets that comprise the Pinwheel, provide GFCI outlets for seasonal LED "glitter" string lights. While poles should accommodate outlets for decorative lighting, the provision of a separate meter or a tariff for use of power should be determined by contract with BED at the time of a project installation.

- Single-color lights are preferred
- String lights should be wrapped around the tree
- Metal clips attached to trees are not recommended

To prevent harming the tree or impeding its growth, the installation of string lights can line the tree branches rather than wrapping around branches.

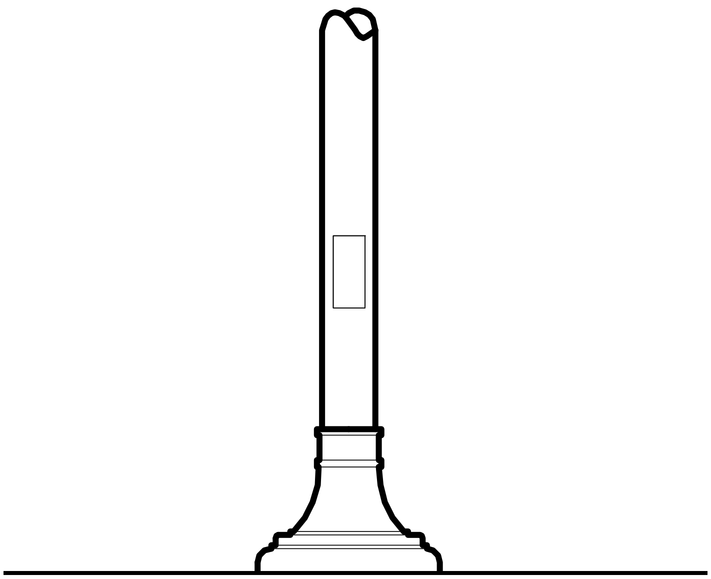




Lighting Elements

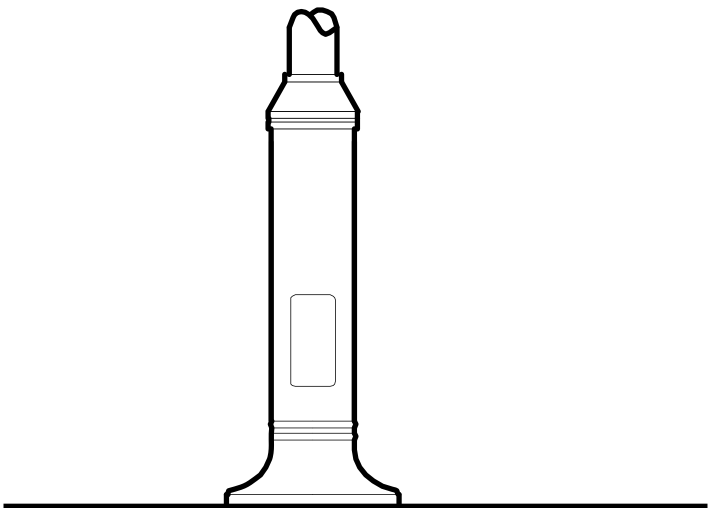
Decorative Lighting Assembly

POLE



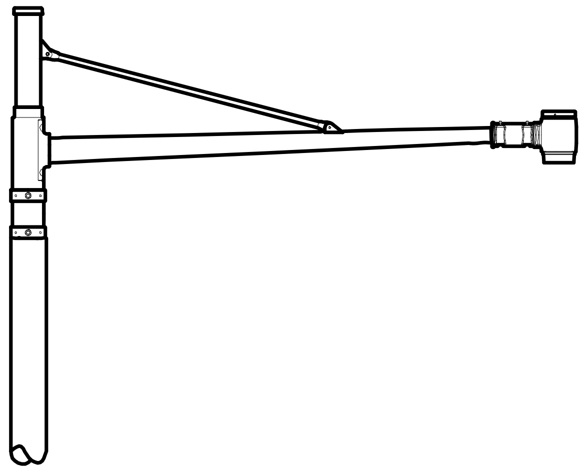
Description:	20' height, 5" diameter straight pole typical, except at signalized intersections
Manufacturers:	Philips Valmont Union Metal Hapco AAL Spring City
Model:	Lumec (Philips)
Finish:	Powder coat—River Texture Black
Notes:	Banner arms and outlets for electricity optional. See ref. dwg. **Center City Steel Shaft Post** in *Appendix section A-6*

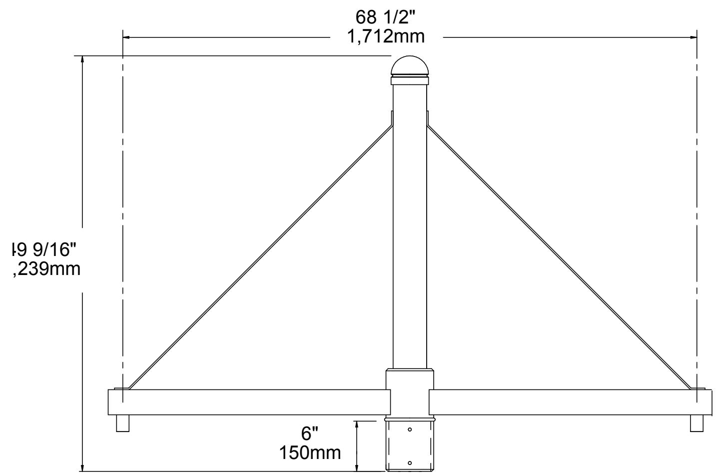
BASE



Description:	Clamshell Cover (Parks Dept. Standard)
Manufacturers:	AAL Sentry Spring City
Model:	DB10 Cover (AAL)
Finish:	Powder coat—River Texture Black
Footing Detail:	See ref. dwg. **VTrans Standard T-133 Light Pole Foundation Details** in *Appendix section A-6*

ARMS/BRACKETS

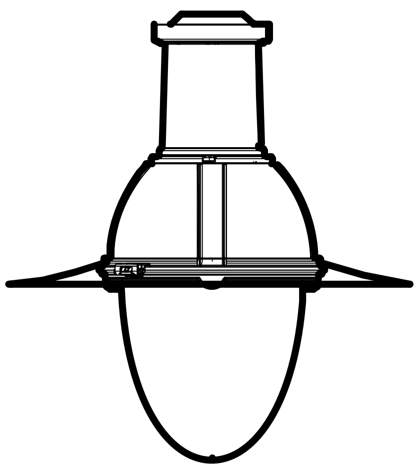




Description:	Single-sided arm
Dimension	Nominal 4' long straight arm
Manufacturers:	Philips Lumec PC4 AAL SLA17(5) (5" pole) Spring City
Finish:	Powder coat—River Texture Black

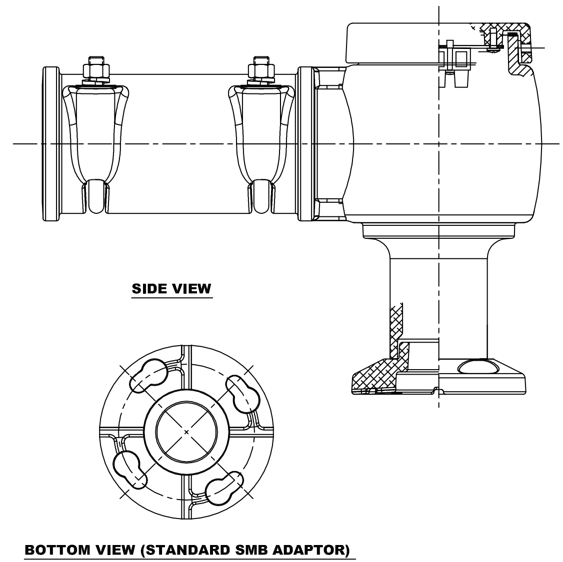
Description:	Double-sided arm
Dimension	Nominal 4' long straight arms
Manufacturers:	Philips Lumec PC4-2 AAL SLA17(5)-2 (5" pole) Spring City
Finish:	Powder coat—River Texture Black

LUMINAIRE



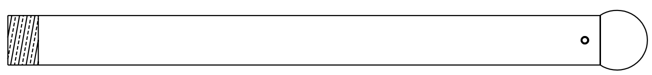
Description	Teardrop luminaire with skirt
Manufacturer/Model	Philips "Renaissance" RNS20 Spring City "Columbia"
Fixture Finish:	Powder coat—River Texture Black
Color Temperature	3000K (warm white)
Color Rendition	80 CRI
Efficacy (Lumens per Watt)	100 lumens per watt
Lamp Life (Years)	100,000 hours
Distribution Type	Type IV (roadway zone) Type II (pedestrian zone)
BUG Rating	B1-U2-G1
Notes	To comply with IES/IDA Model Lighting Ordinance, must meet B3-U3-G3 or better. Must have integral photocell for light sensing. Option incorporation of device for dimming via wireless control based on LZ3 of the BUG Rating Chart (*Figure 7, page 258*) For specifications see ref. doc in *Appendix section A-7*

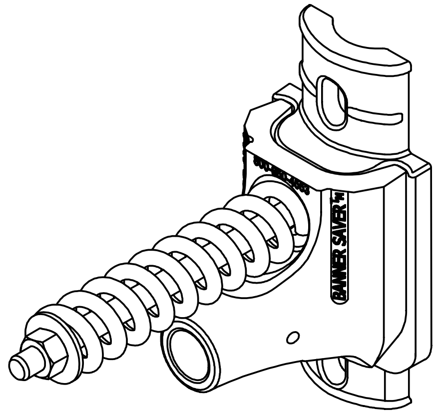
LUMINAIRE ADAPTOR



Description	Standard adapter to rotate recommended luminare by 90 degrees increment.
Manufacturer/Model	Philips Adaptor for RNS20-30 Small Renaissance LED
Notes	See ref. docs in *Appendix section A-7*

Banner Arm & Bracket





Description	Banner Arm
Manufacturer/Model	Britten
Fixture Details	Steel pipe with cast aluminum ornamentation Powder coat—River Texture Gloss Black
Notes	See ref. dwg. **Spring City—Banner Arm** in *Appendix section A-6*

Description	Banner Saver
Manufacturer/Model	Britten
Fixture Details	Black, Cast Aluminum
Size	Small
Notes	For installation of banner arms on existing decorative poles in downtown when not being upgraded to Great Streets Standards. See ref. dwg. **Britten Banner Saver** in *Appendix section A-6*

Standard Lighting Assembly

LAMP

Description:	Cobrahead LED
Manufacturer:	Philips
Model:	RoadView RVS
Dimensions:	21.38”L x 15.38”W x 2.38”–4.66”H
Weight:	23–26 lbs.
Color Temperature:	Nominal 3000K CCT
Finish:	Gray


150
all new
house-made
soups

7 Materials & Furnishings Palette

The materials and furnishings utilized within a streetscape contribute to a street's overall achievement of Great Streets goals: to be vibrant, walkable, sustainable, and durable. This palette identifies recommended and alternative elements which will further these goals and allow for their flexible application based on individual project budgets, priorities, and constraints.

Photo credit Justin Martin—http://flic.kr/p/rktyLR

Materials for Pedestrian & Roadway Zones

This section provides information about the recommended and alternative materials to be utilized within the Roadway and Pedestrian Zones.

Roadway Zone Material

BITUMINOUS (ASPHALT) PAVEMENT

This section includes standards for all temporary and permanent installations of bituminous bases and surfaces for roadway, driveways and parking areas.

Bituminous material shall not be applied between November 1 and May 1. The courses shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is below 40°F. Placing shall not begin until the air temperature is at least 40°F and rising. The Cown Engineer may authorize in writing construction of bituminous concrete pavements at lower atmospheric temperatures than those specified or may extend the dates of the paving season. No pavement shall be laid in the rain and the underlying course shall be dry during paving operations.

Each load shall be covered with canvas or other suitable material of ample size to protect it from the weather. Deliveries shall be made so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight, or at night if the weather is acceptable. The mixture shall be delivered to the area to be paved in such a manner that the temperature at the time of dumping into the spreader will not be less than that specified. The range of acceptable temperatures of mixture delivered to the spreader shall be not less than 225°F nor more than 325°F. Material not within this temperature range shall be rejected. Hauling over freshly laid material will not be permitted.

Materials

- Aggregate for base and surface courses shall consist of clean, hard, durable particles of crushed stone, gravel, sand and fine mineral particles conforming to "VTRANS" Spec. Section 704.
- The aggregates for bituminous concrete pavement shall be crushed stone, crushed gravel and/or sand uniformly graded per ASTM D692-69, ASTM D1073-69, ASTM D242-64.
- Asphalt cement for use in the construction of bituminous concrete pavements shall be prepared by refining crude petroleum by suitable methods and shall conform to Standard Specification for Asphalt Cement for Use in Pavement Construction, ASTM D946-69. The grade of asphalt shall be AC5, AC10, or AC20 as directed by the Design/Project Engineer.
- Emulsified asphalt shall conform to Standard Specifications for Emulsified Asphalt, ASTM D977-69.
- All bituminous Concrete shall be prepared in accordance with standard specifications for Hot-Mixed, Hot-Laid Asphalt Paving Mixtures ASTM D2629-60 which have been prepared in a plant which conforms to ASTM D995-67.

Materials shall be combined and graded to the composition limits by weight set in Section 406 of the State of Vermont Department of Highway Standards Specifications.

Before any base course material is laid, the subgrade shall be prepared in a proper manner. In all cases the top 6 inch layer of subgrade material shall be compacted in such a manner as to secure not less than 95% of the maximum density as determined by ASTM D1557/AASHTO T180 Method A (Modified Proctor) test.

All materials used for the construction of the subgrade, base and surface shall be unfrozen and free from organic or other deleterious matter. No subgrade, base or surface construction shall take place at temperatures below 40°F.

Mineral aggregate base and surface courses shall be placed in layers not to exceed 8 inches loose depth and 6 inches compacted depth.

After each layer is placed it shall be compacted with an approved roller weighing not less than 8 tons, or a rubber tired roller approved by the Engineer. Rolling of each layer shall be continued until a firm, solid and unyielding base is established before the next layer is begun. During compaction, the surface shall be of uniform texture and graded to obtain a true even surface.

Prior to laying the surface course, the underlying course shall be cleaned of all foreign or unsuitable material.

If the bottom course of bituminous concrete pavement is left over 30 days, the existing surface shall be cleaned.

All longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the finish coat. Any large cracks in a bituminous surface shall be thoroughly cleaned and filled with a bituminous material or mixture approved by the City Engineer. Emulsified asphalt shall then be applied to the existing pavement in a manner approved by the Town Engineer. Contact surfaces such as curbing, gutters and manholes shall be painted with a thin, uniform coat of Emulsified Asphalt, immediately before the bituminous concrete mixture is placed against them.

Compaction shall be done by three wheel rollers or tandem rollers having a gross weight of not less than 8 tons and capable of providing a minimum compactive effect of 250 pounds per inch of width of drive roller. The rollers shall also be equipped with tanks and sprinkler bars for wetting the rollers.

Joints between old and new pavements or between successive day's work shall be made so as to insure a thorough and continuous bond between the old and the new pavement. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed and a joint constructed.

Butt joints shall be formed by rutting the pavement in a vertical plane at right angles to the centerline. The butt joint shall be thoroughly coated with Emulsified Asphalt just prior to depositing the paving mixture.

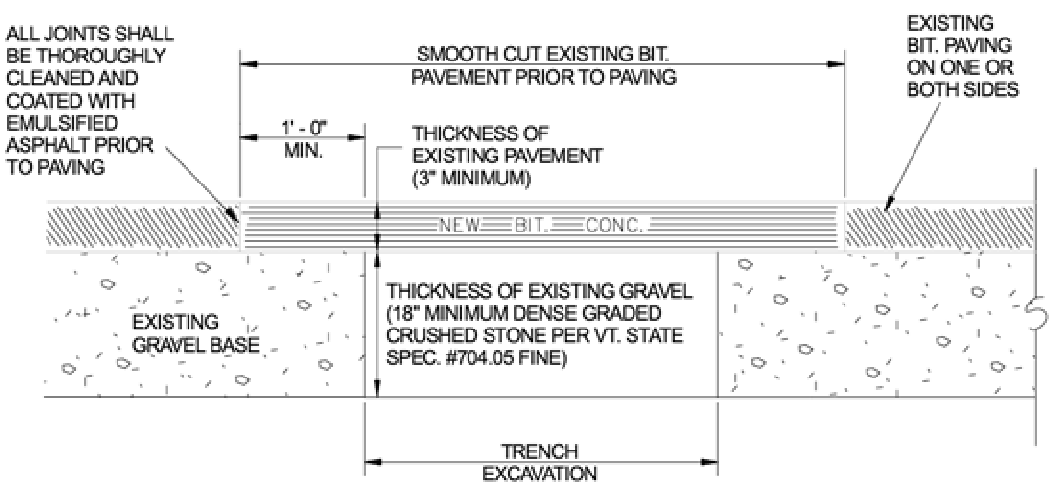
Longitudinal joints that have become cold shall be coated with Emulsified Asphalt before the adjacent mat is placed. If they have been exposed to traffic, they shall be cut back to a clean vertical edge prior to painting with the emulsion.

Additional Resources

VTrans Standard D-11 Steel Grate; Cast Iron Grate Type A; Cast Iron Cover in *Appendix section A-1*

VTrans Standard D-15 Precast Reinforced Concrete Catch Basin w/ Cast Iron Grate; Precast Reinforced Concrete Manhole w/ Cast Iron Cover; Cast Iron Grate w/ Frame, Type D; Cast Iron Grate w/ Frame, Type E in *Appendix section A-1*

Information on colored asphalt can be found under *"Colored Asphalt" on page 169* in the *"Bikeways"* section.



1. SET UP AND MAINTAIN TRAFFIC CONTROL SIGNS AND OTHER SAFETY DEVICES.
2. RESHAPE HOLE AND PATCH AREA BY CUTTING WITH A CONCRETE SAW INTO SQUARE OR RECTANGULAR SHAPE AND CUT SIDE FACES VERTICALLY. RESHAPE DOWNWARD TO SOLID MATERIAL AND AROUND HOLE TO SOUND PAVEMENT.
3. BACKFILL TRENCH IN 6" LIFTS AND COMPACT EACH LIFT TO 95% OF MAXIMUM DENSITY OF OPTIMUM MOISTURE CONTENT AS DETERMINED BY ASTM D1557 / AASHTO T180 METHOD A MODIFIED PROCTOR.
4. REMOVE ALL LOOSE MATERIAL AND THOROUGHLY SWEEP THE HOLE AREA CLEAN OF MUD AND STANDING WATER.
5. APPLY LIQUID ASPHALT TACK COAT TO VERTICAL FACES IN A UNIFORM MANNER. DO NOT PUDDLE TACK COAT ON BOTTOM OF HOLE.
6. FILL TOP OF HOLE WITH TYPE III BITUMINIOUS CONCRETE AND COMPACT IN LIFTS NO MORE THAN 2" THICK. FINAL UNCOMPACTED LIFT SHOULD BE 1/2" TO 1" ABOVE ADJOINING PAVEMENT SO THAT AFTER COMPACTION THE PATCH IS LEVEL WITH THE ORIGINAL PAVEMENT. EACH LIFT SHOULD BE THOROUGHLY COMPACTED WITH A VIBRATORY PLATE COMPACTOR OR A PORTABLE ROLLER. HAND TAMP SHOULD ONLY BE USED FOR SMALL AREAS (LESS THAN 1 S.F.).
7. CLEAN UP AREA. DO NOT LEAVE EXCESS FILL OR EXCAVATED MATERIAL ON THE PAVEMENT. REMOVE SAFETY SIGNS.

Figure 11: *Replacement of Bituminous Pavement*

Painted Pavement Markings

Markings shall be in accordance with 646.06 of the Vermont Standard Specifications.

All lines shall be clear and distinct with sharply defined edges. Paint shall be applied at the rate of 70.0–73.15 square feet per gallon with glass beads applied at a rate of 8 pounds per gallon of paint for painted pavement markings.

Reflectorized paint pavement markings shall be applied by a method in which the liquid paint is applied to the road surface and the glass beads are immediately applied on the paint and firmly embedded therein, and which shall provide a retroreflective marking, with a night visibility satisfactory to the Municipality. The material shall have a minimum wet film thickness of 22 ± 1 mil for paint, unless otherwise specified, and shall be applied in a smooth uniform coat, free from thin places or films of excessive thickness.

Paint lines immediately after all aspects of the paving operations have been completed and before dirt or moisture can accumulate on pavement surfaces.

Carefully layout and define all painted lines on the surface of the pavement, by means of chalk markings, before painting, and accurately paint all lines within the limits and to the dimensions indicated on approved drawings. All surfaces must be thoroughly cleaned before lines are painted.

Reference
Ref. dwgs. **VTrans Standard E-191; E-192; E-193 Pavement Marking Details** in *Appendix section A-1.*

Parking Lane

ALTERNATE OPTION (PILOT)

Permeable Pavers

Dimensions	Parking lane: 8' W typical 6" concrete band on travel lane side
Material	Clay brick permeable paver 4" x 8" x 2 ¾"
Manufacturer	Whitaker Greer, Belden, Pine Hall
Note	Permeable pavers in parking lane should be pilot first.

Curbs

RECOMMENDED OPTION

Granite Curb

Dimensions	6" width
Material	Granite
Note	Segments of curb longer than 100' of replacement, or half a block of project, replace with granite. Minimum lengths of straight segments of sloped curb shall be two (2) feet. All other straight curb types shall have three (3) feet minimum lengths. Generally, curb segments on curves with radii of one hundred (100) feet or less shall be shaped to the required curvature and the ends cut on radial lines. Curves of over one hundred (100) feet radii shall use straight curb segments.
Reference	Ref. dwg. **VTrans Standard C-10 Curbing** in *Appendix section A-2* Ref. dwg. **VTrans Standard C-2BM** in *Appendix section A-2*

	Least				Most
Aesthetics					●
Upfront Cost					●
Durable					●
Available				●	

ALTERNATE OPTION

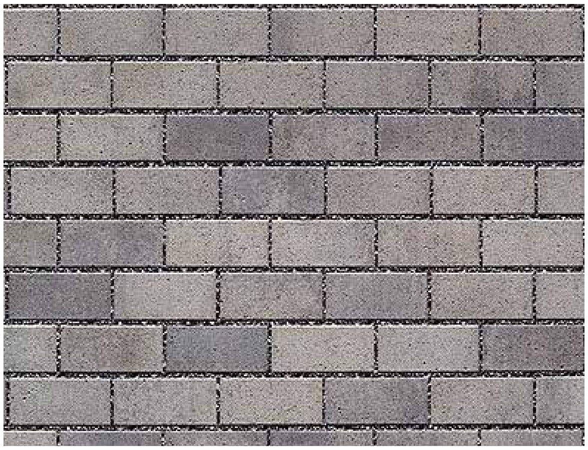
Cast in Place Concrete Curb

Dimensions	6" width
Material	Concrete
Note	Segments of curb that are less than 100' and are currently concrete, replace with concrete.
Reference	Ref. dwg. **VTrans Standard C-10 Curbing** in *Appendix section A-2*

	Least				Most
Aesthetics		●			
Upfront Cost		●			
Durable		●			
Available					●

Tree Belt Permeable Pavers

RECOMMENDED OPTION



4" x 8" Concrete Brick

Manufacturers	Techo Bloc, Unilock, E.P. Henry, Nicolock
Dimensions	4" x 8" x 3" (nominal) preferred, or similar
Material/Finish	Precast Concrete Brick, sealed Dense finishes only. Washed, Tumbled, or Brushed finishes **NOT** recommended.
Paver Style/Color	Techo Block—Victorien: Shale Grey Unilock—Eco-Priora: Winter Marvel
Pattern	Running Bond—Parallel to Street
Void Space	6–12%
Joint Width	.25"–.5"
Non-Permeable Opt.	Available
Performance	Paver & Base must support H-20 vehicular loading while allowing infiltration to soils below.
Installation	Install per manufacturer instructions to accommodate site-specific needs (utilities, Soil Cells, salt, etc.)
Note	Concrete pavers are less durable than clay pavers in high-salt environments. *Appendix section A-8*

	Least				**Most**
Aesthetics				●	
Upfront Cost			●		
Durable			●		
Available					●

Clear Sidewalk & Frontage Zones

Figure 12: *Concrete sidewalk with 3' x 4' running bond pattern with long side perpendicular to curb.*

Cement Concrete Sidewalk

This includes a sidewalk made of one course Portland cement concrete not less than five inches (5") thick and with a width of not less than five feet (5'). Where the sidewalk crosses a driveway, the depth of concrete shall not be less than five inches (5") for residential driveways and eight inches (8") for commercial and industrial driveways for the full width of the driveway.

All concrete used in the construction of cement concrete sidewalks shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 4,000 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

Preparation of subgrade: All boulders, organic material, soft clay, spongy material, and any other unsuitable material shall be removed and replaced with approved material. The sub- grade shall be properly shaped, rolled, and uniformly compacted to conform with the accepted cross-sections and grades.

Base: A minimum base depth of six inches (6") of compacted crusher run gravel (704.05) or sand (704.03) shall be constructed on the subgrade to accepted cross-sections and grades.

Forms for concrete: The forms for the concrete shall be of wood or metal, well-oiled, straight, free from warps or kinks, and of sufficient strength. They shall be staked securely enough to resist the pressure of the concrete without spring. When ready for the concrete to be deposited, they shall not vary from the approved line and grade and shall be kept so until the concrete has set.

Placing and finishing concrete: Just prior to placing the concrete, the subgrade shall be moistened. After being mixed to the proper consistency, the concrete shall be placed in the forms and thoroughly tamped in place so that all honeycombs will be eliminated and sufficient mortar will be brought to the surface. After this, the surface shall be brought to a smooth, even finish by means of a float. The surface shall be broom finished. All faces adjacent to the forms shall be spaded so that after the forms are stripped the surface of the faces will be smooth, even, and free of honeycombs. All edges shall be tool-rounded with an edge having a quarter inch (¼") radius.

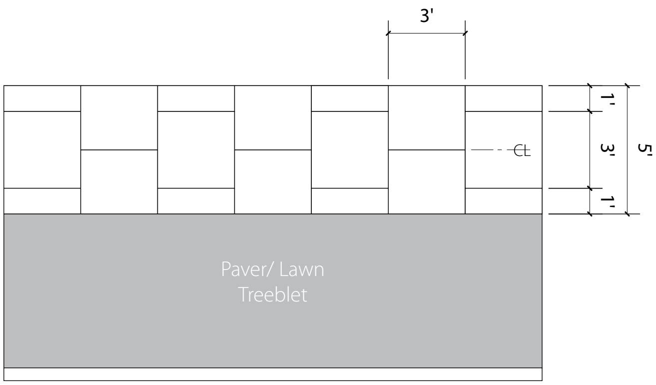
Expansion joints and scoring concrete: Half-inch (½") transverse expansion joints shall be placed at intervals not exceeding twenty feet (20'). Sidewalks shall be scored to a depth of one inch (1") every three feet (3'). Preferred scoring pattern to be "running bond" per *Figure 9*. Curb and sidewalk sections shall be separated by an expansion joint constructed of material conforming to AASHTO Designation M-135.

Curing the concrete: When completed, the concrete shall be kept moist for a period of not less than three days or longer if the Design/Project Engineer or Building Inspector deems necessary and shall be protected from the elements in an approved manner. The Contractor shall apply Lin-Seal White curing and anti-spalling compound to the concrete according to directions of the manufacturer.

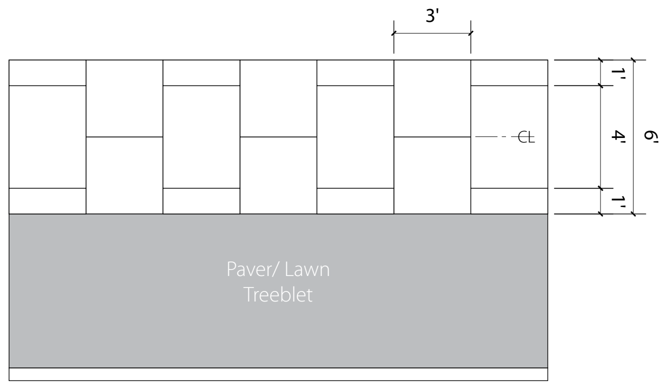
Backfilling: Backfill shall be of suitable bank run gravel and shall be placed and tamped until firm and solid. Backfilling shall follow immediately after the concrete forms have been removed.

Seasonal limits: No concrete shall be poured on a frozen or thawing subgrade during unseasonable weather conditions or when the temperature is 38°F and falling. The Contractor shall record the temperature daily as outlined in the Proposed Recommended Practice - Cold Weather Concreting, ACI 306. In hot weather, the temperature of freshly placed concrete shall not be allowed to exceed 85°F, conforming to ACI 305.

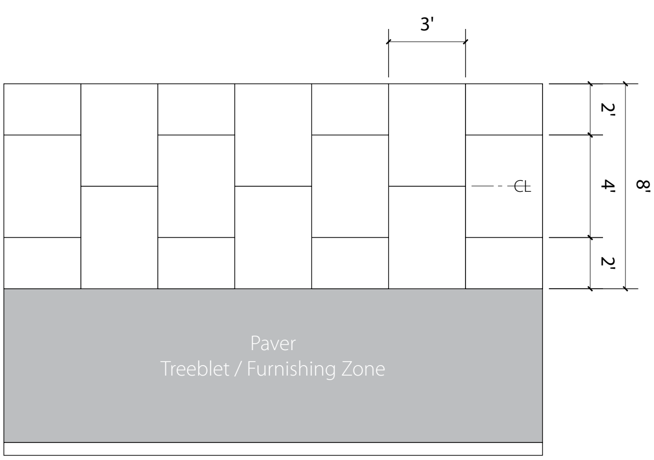
Sidewalk Scoring Pattern—Running Bond



Applied to 5' Minimum width
Clear Sidewalk Zone

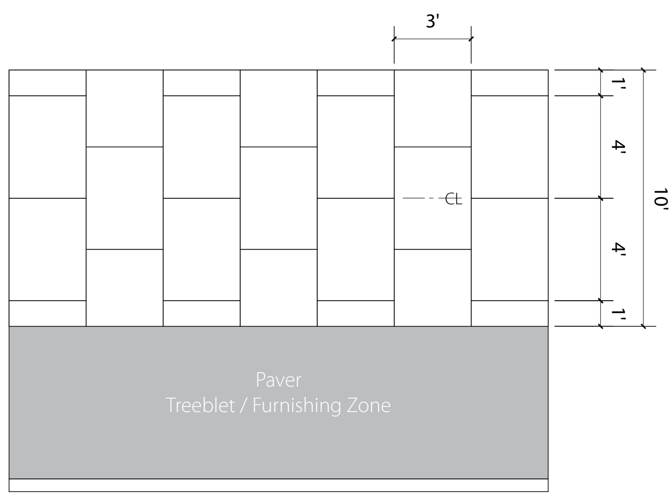


Applied to 6' Preferred width for
Clear Sidewalk Zone on Residential Street Types



Applied to 8' width combined
Clear Sidewalk Zone & Frontage Zone

**Where this dimension is greater than 8' but less than 10', the dimension of the outermost rectangles should be adjusted. The pattern should always begin with a 4' rectangle centered within the sidewalk width.*



Applied to 10' width combined
Clear Sidewalk Zone & Frontage Zone

**Where this dimension is greater than 10', the dimension of the outermost rectangles should be adjusted. The pattern should always begin with two 4' rectangles centered within the sidewalk width.*

Crosswalks

ARECOMMENDED OPTION

Conventional Continental Crosswalk

Dimensions	• 8' minimum width • 10'–12' feet preferred (Residential) • 14'–16' feet preferred (Commercial) • Extra width should be used for high pedestrian volumes or to increase visibility of crossing. Stop lines (when used): • 4' min. in advance of crosswalk • 12" wide
Pattern	• 12"–24" wide stripes • 12"–24" stripe spacing Longitudinal lines parallel to flow of traffic extending the full width of the roadway
Material	White retroreflective thermoplastic
Note	Preferred use is only on Residential Street Types, and at uncontrolled/unsignalized midblock crossings.
Reference	See *"Crosswalk" on page 108*

	Least				Most
Safety				●	
Functional			●		
Maintenance			●		
Available					●

ALTERNATE OPTION

Brick & Granite Crosswalk

Dimensions	• 8' minimum width • 14'–16' feet preferred (Commercial) • Extra width should be used for high pedestrian volumes or to increase visibility of crossing. Stop lines (when used): • 4' min. in advance of crosswalk • 12" wide
Pattern	• 8" × 4" brick pavers in herringbone pattern • 12" wide granite banding each side • 12" wide reflective banding each side Granite banding and transverse lines extend the full width of the roadway.
Material	Brick pavers, granite banding, and white retroreflective thermoplastic
Note	Preferred use is at all intersections in high pedestrian areas within the core of downtown.
Reference	See *"Crosswalk" on page 108*

	Least				Most
Safety					●
Functional				●	
Maintenance				●	
Available				●	

ALTERNATE OPTION

Enhanced Crosswalk (PILOT)

Enhanced crosswalks are preferred in high visibility concern areas of downtown. When using this type of treatment, consideration must be given to safe accommodation of people with disabilities. To accommodate these users, care should be taken to ensure that the material used in these crosswalks is firm, stable, slip resistant and visible. Textured pavements are generally preferable over actual decorative material such as bricks or pavers, however they can still present a bumpy surface. The use of colored and textured crosswalks alone without any additional pavement markings does not legally constitute a marked crosswalk. One of the MUTCD approved crosswalk patterns must be used to delineate the colored and/or textured area. However, the preferred marking is the MUTCD "standard" (two parallel transverse white lines) crosswalk marking that extend the full width of the roadway.

Dimensions	See recommended crosswalk
Pattern	TBD
Material	• Inlaid preformed thermoplastic crosswalk pattern. • Inlaid using infrared heating equipment. • ADA compliant - pedestrian and wheelchair friendly surface. • High skid/slip resistant for safety.
Reference	See *"Crosswalk" on page 108*

	Least				Most
Safety					●
Functional					●
Maintenance					●
Available		●			

CUSTOM OPTION

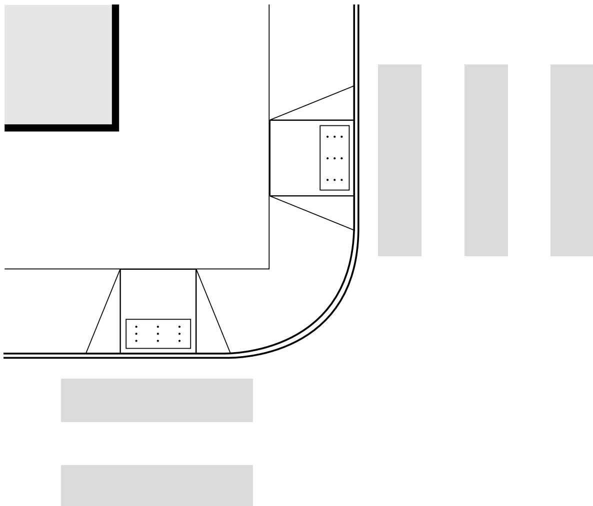
Custom Designed Crosswalk (PILOT)

Occasionally, custom designed crosswalks are installed to increase visibility or to highlight and/or celebrate a piece of infrastructure or an issue in the community. Custom crosswalks are most often created through the use of paint, and typically last only a season. The use of colored and textured crosswalks alone without any additional pavement markings does not legally constitute a marked crosswalk. One of the MUTCD approved crosswalk patterns must be used to delineate the colored and/or textured area. However, the preferred marking is the MUTCD "standard" (two parallel transverse white lines) crosswalk marking that extend the full width of the roadway.

Dimensions	See recommended crosswalk
Pattern	TBD, Custom 12" wide reflective banding on each side
Material	• Traffic Paint • White retroreflective thermoplastic for transverse lines
Note	Requires review and approval by City Engineer
Reference	See *"Crosswalk" on page 108*

	Least				Most
Safety				●	
Functional			●		
Maintenance				●	
Available		●			

Curb Ramp



Flared

Description	Paired perpendicular curb ramps from level landing—side flares with detectable warning strip.
Conditions	Typical for downtown commercial streets where continuous circulation is desired. Pedestrians are able to approach the ramp from multiple directions.
Notes	Catch basins should be located uphill of a curb ramp in order to avoid puddling and freezing in the flattest part of the ramp.
Reference	*"Curb Ramp" on page 109* Ref. dwg. **VTrans Standard C-3A Sidewalk Ramps** in *Appendix section A-3*

Drive Entrances

Where sidewalks intersect driveways—both those that are constructed with with curb returns and those that are similar to curb ramps (i.e., without curb returns)—the sidewalk material should be carried across the driveway (see diagrams on following page). This design detail alerts drivers that pedestrians have the right of way and provides a more continuous pedestrian facility. Driveways and driveway aprons that are constructed like ramps, with steep, short side flares, can render a section of sidewalk impassable, especially when encountered in series, as in residential neighborhoods. Compound cross-slopes, such as those that occur at the flares of a driveway apron or curb ramp, may cause tipping and falling if one wheel of a chair loses contact with the ground or the tip of a walker or crutch cannot rest on a level area. A level area, or area with minimal cross-slope (2% or less) is necessary for accessible passage across a driveway.

To maintain an acceptable cross-slope and facilitate wheelchair movement at driveways, consider using one of the following techniques to prevent an exaggerated warp and cross-slope:

- Construct wide sidewalks to avoid excessively steep driveway slopes. The overall width must be sufficient to avoid an abrupt driveway slope.
- Incorporate buffer zones so the sidewalk can remain level, with the driveway grade change occurring in the buffer zone.
- Where constraints do not allow a buffer strip, wrapping the sidewalk around driveway entrances has a similar effect, although this method may have disadvantages for pedestrians with sight impairments who follow the curb line for guidance.
- When constraints allow for only minimal sidewalks behind the curb, dipping the entire sidewalk at approaches keeps the cross-slope at a constant grade. This may be uncomfortable for pedestrians and may create drainage problems behind the sidewalk.

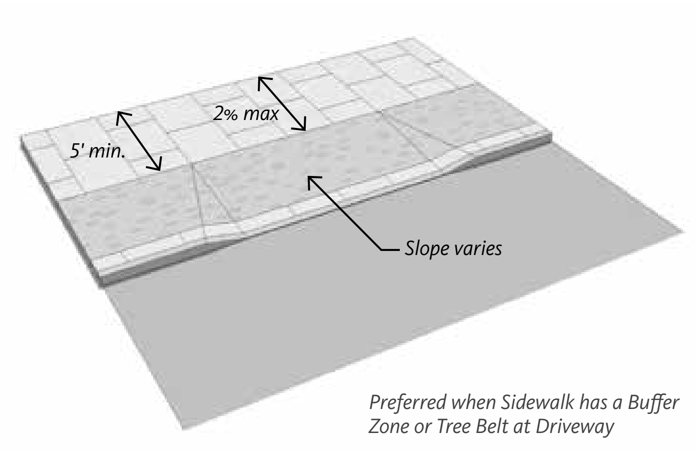
Ref. dwg. **VTrans Standard B-71 Standards for Residential and Commercial Drives** in *Appendix section A-2.*

Ref. dwg. **VTrans Standard C-2A Sidewalk Drive Entrance with Sidewalk Adjacent to Curb** in *Appendix section A-2.*

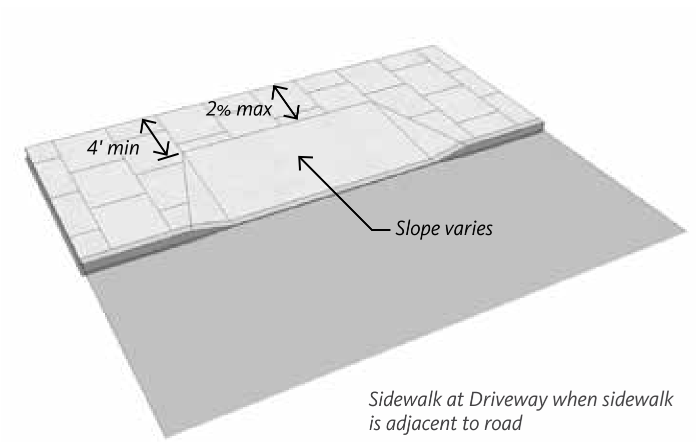
Ref. dwg. **VTrans Standard C-2B Sidewalk Drive Entrance with Sidewalk and Green Strip** in *Appendix section A-2.*

Ref. dwg. **VTrans Standard C-2BM Portland Cement Concrete Sidewalk Drive ENtrances with Vertical Granite Curb** in *Appendix section A-2*

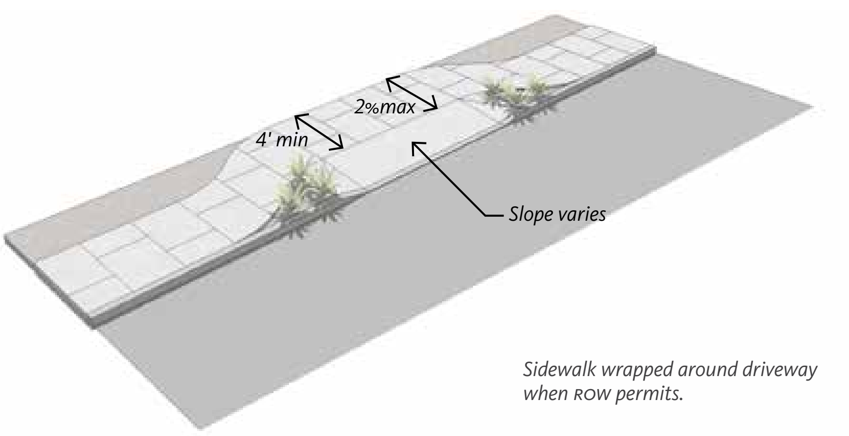
Drive Entrance with Curb Ramp



Preferred when Sidewalk has a Buffer Zone or Tree Belt at Driveway

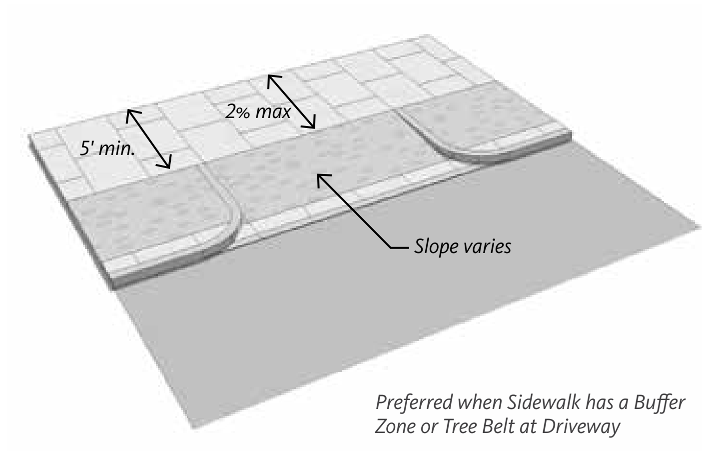


Sidewalk at Driveway when sidewalk is adjacent to road

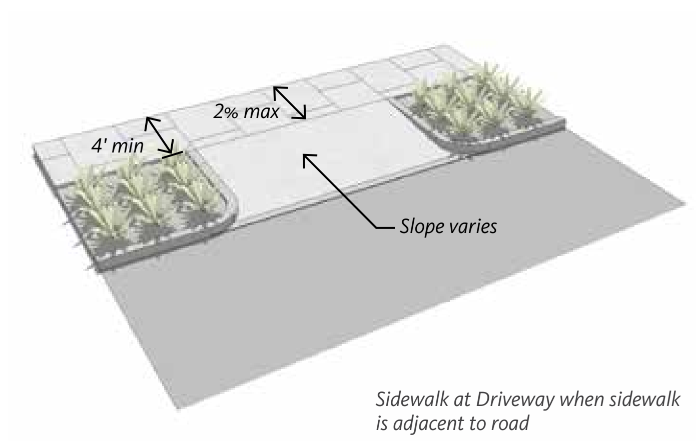


Sidewalk wrapped around driveway when ROW permits.

Drive Entrance with Curb Return



Preferred when Sidewalk has a Buffer Zone or Tree Belt at Driveway



Sidewalk at Driveway when sidewalk is adjacent to road

Detectable Warnings/ Truncated Domes

A detectable warning is a unique and standardized surface by ADAAG (ADA for Accessible Design) intended to function much like a stop sign to alert pedestrians who are blind or visually impaired to the presence of hazards in the line of travel. Truncated domes are highly detectable by pedestrians with visual impairments so they can determine the end of the sidewalk and the beginning of the traveled way.

Shall be furnished and installed in conformance with ADA Accessibility Guidelines. Install detectable warnings:

- At the edge of depressed corners.
- At the border of raised crosswalks and raised intersections.
- At the base of curb ramps.
- At the border of medians and islands.

Detectable warning surfaces should extend a minimum of two feet (2') in the direction of travel. The surface should also extend across the full width of the curb ramp or flush surface. Detectable warning designs using truncated domes should comply with the following specifications.

Truncated domes must have a base diameter of 0.9 inches minimum to 1.4 inches maximum, a top diameter of 50% minimum to 65% maximum of the base diameter, a height of 0.2 inches, a center-to-center spacing of 1.6 inches minimum to 2.4 inches maximum measured along one side of a square arrangement and a base-to-base spacing of 0.65 inches minimum.

Align domes on a square grid in the predominant direction of travel to permit wheels to roll between the domes. Truncated dome surfaces should not be used for wayfinding or directional information.

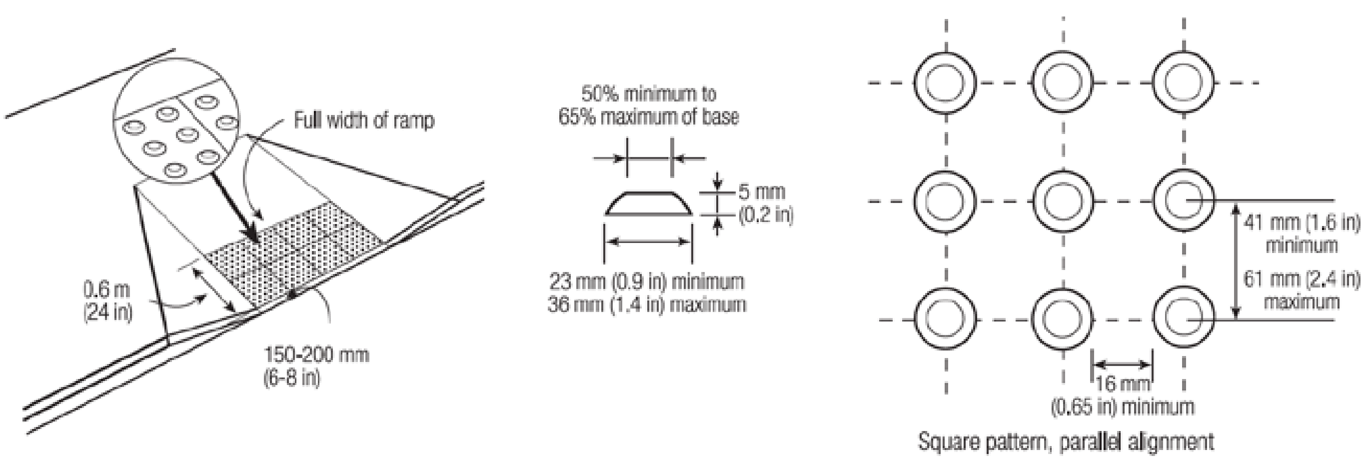
For pedestrians with low vision, there should be at least a 70% contrast in light reflectance between the detectable warning and an adjoining surface, or the detectable warning can be yellow. The material used to provide visual contrast is an integral part of the detectable warning surface and can be dark-on-light or light-on-dark.

Material

Cast iron, non-coated truncated domes/detectable warning plates.

Fabricators

The Detectable Warning Surface shall be supplied by East Jordan Iron Works, Inc., of East Jordan, MI, or Neenah Foundry, Neenah, Wisconsin, and installed in accordance with manufacturer requirements and recommendations for environmental conditions, surface preparation, installation and curing procedures, and materials compatibility.



Detectable warnings/truncated domes on curb ramps.

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Furnishings for Pedestrian Zones

This section provides a palette of recommended and alternative furnishings to be utilized within the Pedestrian Zone.

Selecting Street Furnishings

This palette of street furnishings has been selected due to their adherence to the Great Streets principles and design goals. In particular, this palette has been selected to complement Church Street's unique visual character and to ensure that streetscapes showcase the unique characteristics of the built environment on adjacent private property.

Street furnishings in this section include recommended and alternate options that ensure streetscapes are unified throughout the downtown through the application of a family of elements. This also provides for variability in individual streetscapes based on character, constraints, and project cost. Several of these furnishings include a rating system which is intended to assist in the selection of the most appropriate furnishing for a project's needs based on the following characteristics:

- **Aesthetics**: Visually appealing, complimentary of downtown character
- **Durability**: Long-lasting, able to withstand urban and winter conditions; low lifecycle cost relative to upfront cost
- **Functionality**: Able to be used in an intuitive and accessible manner
- **Safety:** Provides the greatest visibility or protection for users, particularly for pedestrians and bicyclists
- **Upfront Cost:** Expense to purchase or install
- **Maintenance:** Expense or labor required to maintain in proper, working condition
- **Availability:** Availability to and familiarity by local contractors/city departments; level of effort or cost associated with acquiring
- **Sustainability:** Recycled, sustainably harvested, other environmental verification

In general, preference should be given to using furnishings that have high durability and sustainability ratings. In particular, street furnishings should not utilize tropical hardwoods (i.e. Ipe) and efforts should be made to secure a locally sourced material if available. Because these furnishings may not be widely available, or may come with greater upfront costs or increased maintenance requirements, alternative options are provided. Additionally, some of these elements have been identified as a pilot, to be tested before being installed widely. This approach will allow the City to test the performance or location of the furnishing, and explore emerging materials or approaches.

Placement of Furnishings

Street furniture—such as benches, kiosks and bike racks—adds to the amenity and interest of the street, encourages social activity, and can help contribute to a distinctive identity for a neighborhood or district. Well designed street furniture makes the sidewalk more comfortable and life on the sidewalk more convenient. In addition to providing amenities, street furniture can also provide a buffer from the noise and commotion of vehicles on the street. Street furniture that is not thoughtfully laid out can obstruct and clutter the sidewalk environment. To create Great Streets, street furniture should be used to enhance mixed use areas, particularly on streets connecting Church Street to the waterfront, around City Hall Park, and other areas with high pedestrian activity, such as near higher volume transit stops.

This section provides design guidelines for street furniture to be located in the Pedestrian Zone. Burlington's street furniture must be organized in a way that maximizes safety, comfort, and function for all users. The design of street furniture should be simple and compatible with the existing built environment. When commissioned, unique and creative designs for street furniture should add to the character of the street and to Burlington's sense of place. However, these elements should adhere to the required basic characteristics, dimensions and performance criteria to ensure that they're durable, safely installed, and accessible to all users.

Street furniture should normally be installed in the Tree Belt/ Furnishing Zone, although it can also be installed in the Frontage Zone and on curb extensions. Street furniture should not be installed in or protrude into the Clear Sidewalk Zone.

For more specific details regarding the placement of these elements within the right-of-way, see *"Street & Intersection Assemblies" on page 80* and *"Element Siting & Considerations" on page 112*.

Benches

RECOMMENDED OPTION

Neoliviano—by Landscape Forms

Dimensions	26.5″ W x 31″ H 3 lengths available: 24″, 69″, 118″
Material	Aluminum frame & thermally modified ash seat and back
Finish	RAL 9007 Gray Aluminum powdercoat
Armrests	Intermediate armrest option available for 118″ bench only
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

	Least				Most
Aesthetics					●
Upfront Cost					●
Sustainability				●	
Availability					●

RECOMMENDED OPTION

Neoliviano Backless—by Landscape Forms

Dimensions	19.5″ W x 17″ H 2 lengths available: 5', 6'
Material	Aluminum frame & thermally modified ash seat
Finish	RAL 9007 Gray Aluminum powdercoat
Armrests	Intermediate armrest not available
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

	Least				Most
Aesthetics					●
Upfront Cost					●
Sustainability				●	
Availability					●

ALTERNATE OPTION

Exposition Contour—by Anova

Dimensions	33" H x 25" W 3 lengths available: 4', 5', 6'
Material	Steel
Finish	RAL 9007 Gray Aluminum powder coat on Plastisol
Dividers	Intermediate skate-deterrent dividers are available with this bench. Install dividers on all benches
Installation	Mount with manufacturer-provided corrosion resistant hardware. Install per manufacturer instructions. Mounting: surface
Manufacturer	Anova
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost			●		
Sustainability			●		
Availability					●

ALTERNATE OPTION

Exposition Contour—by Anova

Dimensions	18"H x 21"W x 74"L 3 Lengths Available: 4', 5', 6'
Material	Steel
Finish	RAL 9007 Gray Aluminum powder coat on Plastisol
Dividers	Intermediate skate-deterrent dividers are available with this bench. Install dividers on all benches.
Installation	Mount with manufacturer-provided corrosion resistant hardware. Install per manufacturer instructions. Mounting: surface
Manufacturer	Anova
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost			●		
Sustainability			●		
Availability					●

ALTERNATE OPTION

Eva Bench-by Victor Stanley (Pilot)

Dimensions	30" H x 25" W 3 Lengths: 2', 4', 6'
Material	Recycled solid steel & Black Locust Board Seat and Back
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum powdercoat
Dividers	Intermediate armrest option for 4' & 6'
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Victor Stanley
Note	Prototype available by manufacturer upon request for a more ecologically sensitive hardwood material. Should be field tested to determine durability. Bench frame should accomodate flat board (not rounded) in order to be replaced with an alternative wood material in the case of failure. *Appendix section A-8*

	Least				Most
Aesthetics					●
Upfront Cost			●		
Sustainability				●	
Availability			●		

ALTERNATE OPTION

Eva Backless Bench-by Victor Stanley (Pilot)

Dimensions	23" H x 18" W 3 Lengths: 2', 4', 6'
Material	Recycled solid steel & Black Locust Board Seat
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum powdercoat
Dividers	Intermediate armrest option for 4' & 6'
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Victor Stanley
Note	Prototype available by manufacturer upon request for a more ecologically sensitive hardwood material. Should be field tested to determine durability. Bench frame should accomodate flat board (not rounded) in order to be replaced with an alternative wood material in the case of failure. *Appendix section A-8*

	Least				Most
Aesthetics					●
Upfront Cost			●		
Sustainability				●	
Availability			●		

ALTERNATE OPTION

Cubic Stone Bench

Dimensions	18–24"H x 24–48"W x 24–96" L
Material	Vermont-Quarried Cubic Granite or Marble
Finish	Sawn thermal-finish top, Split or Sawn thermal-finish sides. Seal per quarry instructions.
Installation	Set on reinforced concrete base to prevent frost-heaving.
Note	When utilized, material should be sourced from Vermont or the US

	Least				Most
Aesthetics				●	
Upfront Cost					●
Sustainability			●		
Availability				●	

ALTERNATE OPTION

(Example custom benches)

Custom Bench

Dimensions	2', 5', or 6' Lengths recommended. Must meet all setback requirements outlined in *"Element Siting & Considerations" on page 112.*
Description	Custom benches may be designed for incorporation into the ROW subject to city approval based on structural performance and aesthetic considerations.
Performance	Custom Benches must be capable of withstanding a concentrated load of 200 lbf applied at any point and in any direction; a uniform load of 50 lbf/ft applied horizontally and concurrently with uniform load of 100 lbf/ft applied vertically downward. Custom Benches shall meet or exceed the requirements of applicable local and state building codes.
Material	Custom Benches must be made of durable materials, capable of resisting corrosion in Burlington's high-salt environment.
Finish	Custom Benches must be finished to resist rust, peeling, chipping, cracking, mold, and mildew. Warranty for 5 years from date of installation.
Installation	Mount permanent Custom Benches to streetscape pavement or a concrete base with corrosion-resistant hardware.

	Least				Most
Aesthetics				●	
Upfront Cost					
Sustainability					
Availability	●				

Movable Chair

ALTERNATE OPTION

Bistro Chair—by Fermob

Dimensions	32” H x 15”D x 16”W
Material	Galvanized & Lacquered Steels
Finish	Storm Grey Powdercoat
Installation	Freestanding
Manufacturer	Fermob
Note	*Appendix section A-8*

ALTERNATE OPTION

Verona—by Landscape Forms

Dimensions	30” H x 25”D x 20–23”W
Material	Tubular Steel Frame, Perforated Metal or Metal Grid Seat Insert
Finish	Pangard II® polyester powdercoat—RAL 9007 Gray Aluminum
Options	With or Without Armrests
Installation	Freestanding
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

Note: These standards provide two options for movable chairs the City may install for use in the public ROW. These may also be utilized by property owners, restaurateurs, residents, and retailers when locating movable seating in outdoor spaces on private property or in public ROW through the encumberance process. However, these are not mandatory, and private operators may select others that better suit their purposes.

Movable Table

ALTERNATE OPTION

Bistro Table—by Fermob

Dimensions	33”DIA x 29”H
Material	Lacquered Steel
Finish	Storm Grey Powdercoat
Installation	Freestanding
Manufacturer	Fermob
Note	*Appendix section A-8*

ALTERNATE OPTION

Parc Centre Table—by Landscape Forms

Dimensions	30” DIA x 30”H
Material	Steel
Finish	Pangard II® polyester powdercoat—RAL 9007 Gray Aluminum
Installation	Freestanding
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

ALTERNATE OPTION

Parc Centre Table—by Landscape Forms

Dimensions	28" L x 28" W x 30" H
Material	Steel
Finish	Pangard II® polyester powdercoat—RAL 9007 Gray Aluminum
Installation	Freestanding - Surface mounting options & leveling feet are available
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

Note: These standards provide three options for movable tables the City may install for use in the public ROW. These may also be utilized by property owners, restaurateurs, residents, and retailers when locating movable seating in outdoor spaces on private property or in public ROW through the encumberance process. However, these are not mandatory, and private operators may select others that better suit their purposes.

Bike Rack

RECOMMENDED OPTION

The Arc—by Huntco

Dimensions	32” H x 28” L x 1 ½” W
Material	Stainless Steel
Finish	#4 Satin Electropolish on Stainless Steel
Installation	Can be installed in treebelt pavers, but must be embedded into a concrete base. Install per manufacturer instructions. Stainless steel mounting hardware with 2 security nuts for surface mount available.
Manufacturer	Huntco
Note	*Appendix section A-8*

RECOMMENDED OPTION

Downtown—by Dero

Dimensions	36” H x 30”L x 2”W
Material	Recycled Mild Steel
Finish	Hot-Dipped Galvanized Finish
Installation	Surface-mounted on a concrete base using corrosion-resistant hardware. When installing the rack in unit pavers, mount below pavement surface to concrete footing and cut pavers to fit posts. Install per manufacturer instructions.
Manufacturer	Dero
Note	*Appendix section A-8*

	Least				**Most**
Aesthetics					●
Upfront Cost				●	
Durability				●	
Available				●	

	Least				**Most**
Aesthetics		●			
Upfront Cost		●			
Durability			●		
Available					●

ALTERNATE OPTION

Bike Hitch—by Dero

Dimensions	35″ H x 16.5″ L x 2.375″ W
Material	Metal Centerbeam: 2″ schedule 40 pipe (2.375″ OD) Ring: 1.5″ OD 11 guage tube
Finish	Galvanized or Stainless Steel
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Dero
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost		●			
Durability				●	
Available					●

CUSTOM OPTION

(Example custom bicycle parking)

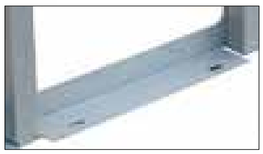
Custom Bicycle Rack

Description	Custom bike racks may be designed for incorporation into the ROW subject to city approval based on structural performance and aesthetic considerations.
Dimension	Maximum dimensions: 48″ H; 12' L Must meet all setback requirements outlined in *"Element Siting & Considerations" on page 112.*
Performance	Bicycle racks must be capable of withstanding a concentrated load of 200 lbf applied at any point and in any direction; a uniform load of 50 lbf/ft applied horizontally and concurrently with uniform load of 100 lbf/ft applied vertically downward. Custom Bicycle Racks must provide two-point support for attached bicycles and allow a standard “U” lock to attach a bicycle to the rack to discourage theft. Bicycle Racks shall meet or exceed the requirements of applicable Local and State building Codes.
Materials	Custom Bicycle Racks & mounting hardware must be made of durable materials, capable of resisting corrosion in Burlington’s high-salt environment.
Finish	Custom Bicycle Racks must be finished to resist rust, peeling, chipping, cracking, mold, and mildew. Warranty for 5 years from date of installation.
Mounting	Mount permanent Custom Bicycle Racks to streetscape pavement or a concrete base with corrosion-resistant hardware.

High-Capacity Bike Parking

RECOMMENDED OPTION

Anchor plate detail



U-Lockit Bike Rack—by Dero

Dimensions	20' L x 8' W
Material	Recycled Mild Steel
Finish	Hot-Dipped Galvanized Finish
Capacity	6+ bicycles Each arm accomodates 2 bicycles. Minimum assembly recommended for stability is 3 bike arms, with required anchor mounting plates. (Image above shows assembly with 4 bike arms)
Note	For permanent or temporary use. May be used in single parking stall as a Bike Corral; see *"Bike Corrals" on page 134* for design and layout guidelines. *Appendix section A-8*

	Least				Most
Aesthetics	●				
Upfront Cost		●			
Durability			●		
Available					●

ALTERNATE OPTION

Cycle Stall Elite—by Dero

Dimensions	40" H x 216"L x 63"W
Material	Recycled Mild Steel
Capacity	14 Bicycles
Finish	Hot-Dipped Galvanized Finish
Permitting	Bicycle Corrals require permits before they are installed in the ROW. The permitting process is outlined in Burlington's 2015 Community-Led Demonstration Project Policy and Guide.
Installation	Mount directly to concrete or asphalt pavement. Install per manufacturer instructions. Install manufacturer-provided traffic delineators and reflectors as included by manufacturer per MUTCD standards.
Manufacturer	Dero
Note	Shall not be used in single parking stall corral configuration due to required buffers from adjacent parking spaces. May be used in double parking stall configuration, either alone or in conjunction with a 12-foot parklet layout. Must maintain required 4' minimum setback from adjacent parking stalls. For use in a Bike Corral; see *"Bike Corrals" on page 134* for design and layout guidelines.

	Least				Most
Aesthetics				●	
Upfront Cost					●
Durability					●
Available					●

Bike Shelter

RECOMMENDED OPTION

Parachute—by Duo-Gard

Dimensions	8' H x 13' L x 8'-6" W
Material	Steel frame Translucent polycarbonate roof panels
Capacity	8 bikes
Finish	Galvanized, or Duo-Gard Paint Process to match RAL 9007 Gray Aluminum
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: surface or embedded
Manufacturer	Duo-Gard
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost					●
Durability					●
Available				●	

Bicycle Repair Station

RECOMMENDED OPTION

Fixit—by Dero

Dimensions	59” H x 20”L x 13”W
Material	Recycled Steel
Finish	Raw, Hot-Dipped Galvanized Finish
Tools Included	Manual air pump Philips and flat head screwdrivers 2.5, 3, 4, 5, 6, 8mm Allen wrenches Headset wrench Pedal wrench 8, 9, 10, 11mm box wrenches
Installation	Surface Mount to Concrete Base using 10” diameter x .25” foot with four anchors per foot. Install per manufacturer instructions.
Manufacturer	Dero
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost			●		
Durability					●
Available					●

Parklet Elements

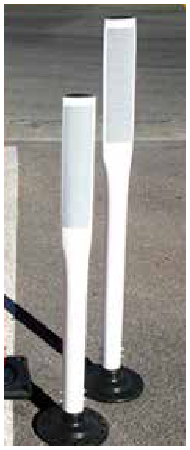
RECOMMENDED OPTION

Parklet—by Dero

Dimensions	168”L x 72”W Additional decking available in 8-foot units
Material	Recycled Mild Steel
Finish	Hot-Dipped Galvanized Finish
Permitting	Parklets require permits before they are installed in the ROW, which is outlined in Burlington’s 2015 Community-Led Demonstration Project Policy and Guide.
Installation	Freestanding. Install per manufacturer instructions with Dero railing and cables. Install with safe-hit posts and tire stops.
Manufacturer	Dero
Note	Shall not be used in single parking stall parklet configuration due to required buffer from adjacent parking stalls. May be used in double parking stall configuration, either alone or in conjunction with bike corral. Must maintain required 4' minimum setback from adjacent parking stalls, and 1.5' minimum setback from travel lane. See *"Parklet Guidelines & Setbacks" on page 128* for design and layout guidelines.

	Least				Most
Aesthetics				●	
Upfront Cost					●
Durability					●
Available				●	

REQUIRED



Safe-Hit Type 2 Guide Post

Dimensions	36" height
Color	White post Silver reflective
Installation	Surface Mount Pin Lock Base (anchor not epoxy)
Notes	Must be used in both off-the-shelf and custom designed bike corral/parklet. See *"Parklet Guidelines & Setbacks" on page 128* for design and layout guidelines.

REQUIRED

Wheel Stops

Dimensions	6" H x 36" L
Material	Concrete
Installation	Mounted with bolts
Notes	Must be used in both off-the-shelf and custom designed bike corral/parklet. See *"Parklet Guidelines & Setbacks" on page 128* for design and layout guidelines.

Bollard

RECOMMENDED OPTION

Isac—by mmcité

Dimensions	34 ⅞” H; Ø 4 ¾”
Material	Cast Aluminum
Finish	RAL 9007 Gray Aluminum Powdercoat
Installation	Install with concrete base per manufacturer specifications. Removable & Fixed Options Available.
MUTCD	Install & modify with retroreflective tape as required by MUTCD in relevant locations.
Manufacturer	mmcité
Note	This bollard should be used whre vehicles are not backing up. They may not be visible to a driver who is reversing. Not suitable for in-street use to separate a bike lane from vehicular traffic. *Appendix section A-8*

	Least				Most
Functionality			●		
Sustainability			●		
Appropriate				●	

ALTERNATE OPTION

DG-4—by Urban Accessories

Dimensions	44”H - Ø 7 3⁄16”
Material	Recycled Aluminum, Bronze Cap
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum Powdercoat. Decorative cast silicon-bronze cap.
Installation	Install with concrete base per manufacturer specifications. Options: surface-mounted; cast-in; removable/lockable
MUTCD	Install & modify with retroreflective tape as required by MUTCD in relevant locations.
Manufacturer	Urban Accessories
Note	This bollard is more appropriate where vehicles may back into, or in the direction of, the bollard. Not suitable for in-street use to separate a bike lane from vehicular traffic. *Appendix section A-8*

	Least				Most
Functionality				●	
Sustainability				●	
Appropriate			●		

Planters

RECOMMENDED OPTION

Sorella—by Landscape Forms

Shape	Shape: Squares & Rectangles
Sizes	12 Sizes available: 18" and 30"Heights (13-137 Gallons)
Material	Stainless Steel
Drainage	Specify drain holes for all outdoor planters
Finish	Satin Finish Pangard II Polyester Powdercoat
Colors	RAL 9007 Gray Aluminum; Grass, Steel, Mercury, Matte Black
Installation	Freestanding. Optional: Surface Mounted with Anchoring Hardware per Manufacturer Specifications. Sorella planters are not appropriate for In-Street Installation.
Manufacturer	Landscape Forms
Note	*Appendix section A-8*

ALTERNATE OPTION

Larkspur—by Landscape Forms

Sizes	3 Sizes Available: 24" H x 36" x 36" 30" H x 48" x 48" 48" H x 32" x 32"
Material	Cast Concrete 5,000–6,000 psi
Colors	Cobblestone, Graphite, Green Slate, Outback, Pebble, Pewter, Willow Green
Installation	Freestanding. Larkspur planters are not appropriate for In-Street Installation.
Manufacturer	Landscape Forms (Kornegay Design)
Note	Specify planters with manufacturer-provided concrete additives included to enhance the concrete's durability in cold weather conditions. *Appendix section A-8*

	Least				Most
Aesthetics				●	
Upfront Cost			●		
Durability				●	
Available				●	

	Least				Most
Aesthetics					●
Upfront Cost					●
Durability				●	
Available		●			

Planters

ALTERNATE OPTION

Downtown Self-Watering—by Tournesol

Shape	Round, Square, Rectangle, Bowl
Sizes	20 Sizes Available: 18″–42″ heights (2–93 cu. ft.)
Material	Fiberglass or Glass Fiber Reinforced Concrete (GFRC)
Drainage	Specify drain holes for all outdoor planters
Colors	Fiberglass Colors: Pitch, Puddle, Reed, Royalty, Shadow, Shark, Smoke GFRC Finish & Colors: Sandblast Finish—Colonial, Shadow, Shark
Installation	Freestanding. Include manufacturer's self-watering container irrigation system
In-Street Installation	Install with traffic delineators and reflectors as required per MUTCD standards
Manufacturer	Tournesol Siteworks
Note	*Appendix section A-8*

	Least				Most
Aesthetics			●		
Upfront Cost				●	
Durability			●		
Available				●	

CUSTOM OPTION

Custom Planter

Shape	Round, Square, Rectangle, Bowl
Sizes	18″–42″ H; 12″–48″ W
Material	Metal, concrete, fiberglass, wood
Drainage	Specify drain holes for all outdoor planters
Colors	To be approved by City
Installation	Freestanding. Include self watering container irrigation system
In-Street Installation	Install with traffic delineators and reflectors as required per MUTCD standards
Manufacturer	Custom
Notes	For use in buffer of a protected bike lane, or as other custom designed element.

Trash/Recycling

RECOMMENDED OPTION

Bigbelly & Smartbelly double station

Dimensions	50"H x 27"D x 51"L
Material	Galvanized Steel & Heavy Duty Plastic
Finish	Manufacturer Standard
Installation	Surface Mounted per Manufacturer Specifications
Sensor	At city request, utilize Connect™ smart waste and recycling system by Bigbelly to monitor and communicate system fill level, performance, and maintenance.
Manufacturer	Bigbelly Solar, Inc.
Note	*Appendix section A-8*

	Least				Most
Aesthetics		●			
Upfront Cost					●
Durability				●	
Available					●

RECOMMENDED OPTION

Steelsites SDC-36—by Victor Stanley

Dimensions	24-½" DIA x 43-⅞" H
Material	Recycled Steel & Heavy Duty Plastic Insert
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum Powdercoat
Installation	Install in pairs (1 Trash, 1 Recycle). Surface Mounted per Manufacturer Specifications.
Capacity	36 gallons
Security	Do not lock
Sensor	At city request, install Victor Stanley Relay™ system to monitor and communicate each receptacle's fill level, weight, location, system temperature, and collection status.
Manufacturer	Victor Stanley
Note	*Appendix section A-8*

	Least				Most
Aesthetics					●
Upfront Cost				●	
Durability				●	
Available				●	

Trash/Recycling

CUSTOM OPTION

Custom Trash Receptacle

Dimensions	44" H x 24" W; square or round (per individual receptacle)
Material	Metal, wood, concrete
Finish	To be approved by City
Installation	Install in pairs (1 Trash, 1 Recycle). Surface Mounted.
Manufacturer	Custom
Performance	Must have a top, shall not be locked, must be installed in pairs, and should include sensor to monitor fill level.

Newsrack

RECOMMENDED OPTION

City Line News Paper Stand—by Lucid Management Group

Dimensions	48" H x 72" L x 24" D
Material	Metal
Finish	RAL 9007 Gray Aluminum Powdercoat
Installation	Mount with manufacturer-provided hardware. Install per manufacturer instructions. Mounting: embedded
Manufacturer	Lucid Management Group
Model	SF-003-002
Performance	Accommodates a range of different publication boxes, including coin pay inserts and/or free publication inserts. Modular design allows for various insert types and sizes as well as easy installation.

Public Toilets

Conveniently located restrooms are welcomed by both residents and tourists and take the pressure off business owners from having to provide sanitary facilities for the general public. Where provided, public restrooms and portable toilet facilities on a site or in the public right-of-way should be accessible.

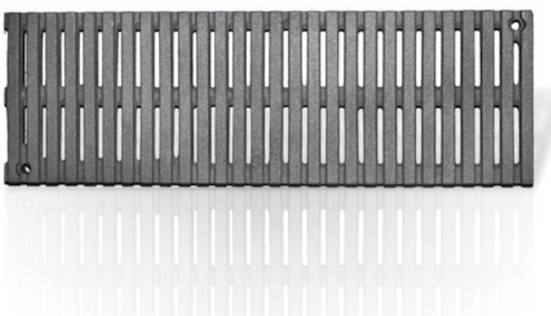
RECOMMENDED OPTION

Portland Loo

Dimensions	10'–7$\frac{1}{2}$" L x 6'–4" W x 8'–9$\frac{1}{15}$" H
Material	SAE 304 stainless steel Carbon steel posts
Foundation	10'–11$\frac{1}{2}$" L x 6'–8" W x 1'–6" D
Installation	Per manufacturer specifications
Manufacturer	Portland Loo
Reference	Portland Loo Structural/Architectural Drawings in *Appendix section A-8*
Note	While the Portland Loo model is recommended initially, the City may wish to pursue a custom option. Additionally, exterior sides may be considered for potential art and/or information displays.

Trench Grate

RECOMMENDED OPTION

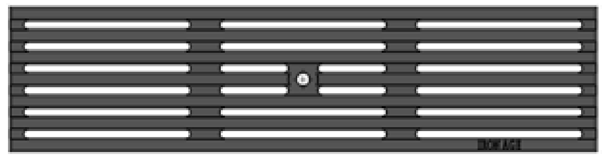


Jamison—by Urban Accessories

Dimensions	9 Sizes Available: 2”–24” width Slot Opening Size: .25”
Material	Ductile Iron
Finish	Raw Natural Finish
Installation	Install per manufacturer specifications to support H-20 Loading. http://www.urbanaccessories.com/product-categories/installation-frames
Manufacturer	Urban Accessories
Similar	"Regular Joe" Heelproof Trench Drain Grate
Note	*Appendix section A-8*

	Least				Most
Functional					●
Upfront Cost				●	
Maintenance		●			
Available				●	

ALTERNATE OPTION



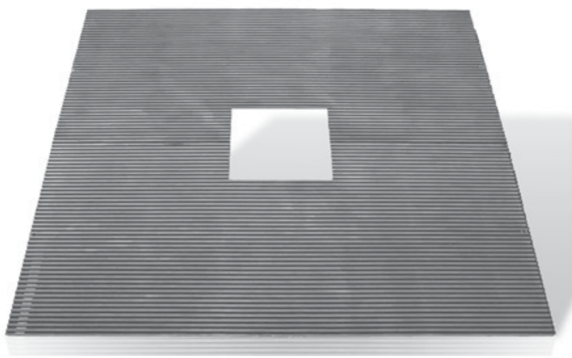
Que Heel Proof—by Iron Age Designs

Dimensions	8 Sizes Available: 2”–12” width Slot Opening Size: .25”
Material	Cast Ductile Iron
Finish	Raw Natural Finish
Installation	Install per manufacturer specifications to support H-20 Loading.
Manufacturer	Iron Age Designs
Reference	Manufacturer website: https://www.ironagegrates.com/product/que/

	Least				Most
Functional				●	
Upfront Cost			●		
Maintenance		●			
Available				●	

Tree Grate

RECOMMENDED OPTION

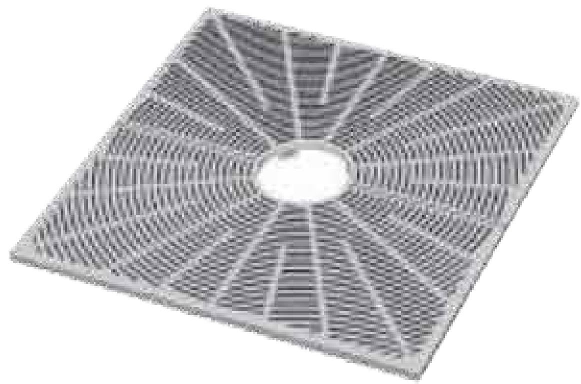


Jamison—by Urban Accessories

Size	6' x 12'; 8' x 16' (Match full Treebelt width)
Tree Opening	17" x 17" square
Slot Opening	.25"
Material	Ductile Iron
Finish	Raw natural finish
Installation	Install to meet H-20 loading requirements in frame per manufacturer-provided specs http://www.urbanaccessories.com/product-categories/installation-frames
Manufacturer	Urban Accessories
Paired with	Any Street Tree Guard
Note	8' x 16' option custom order Detail drawings in *Appendix section A-8* For center opening expansion instructions, see details in *Appendix section A-8*

	Least				Most
Functional					●
Upfront Cost				●	
Maintenance			●		
Available			●		

ALTERNATE OPTION



Boulevard—by Neenah

Size	6' x 6'; 8' x 8' (Match full Treebelt width)
Tree Opening	Ø 16"
Slot Opening	.375"
Material	Cast iron
Finish	Raw natural finish
Installation	Install to meet H-20 loading requirements in frame per manufacturer-provided specs
Manufacturer	Neenah
Paired with	S-6 Tree Guard
Note	Tree grate allows for easy expansion of diameter of opening for tree as tree grows.

	Least				Most
Functional				●	
Upfront Cost		●			
Maintenance			●		
Available				●	

Tree Guard

RECOMMENDED OPTION

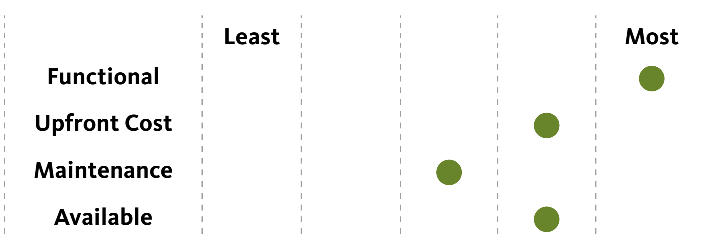
Any Street—by Urban Accessories

Dimensions	Height: 60” Opening: 15 5/8” x 15 5/8”
Material	Mild Carbon Steel
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum Powdercoat
Installation	Mount to Jamison Tree Grate per Manufacturer specifications with corrosion-resistant hardware.
Manufacturer	Urban Accessories
Paired With	Jamison Tree Grate
Note	Install without removable Street Number Panel *Appendix section A-8*

ALTERNATE OPTION

S-6—by Victor Stanley

Dimensions	Height: 48” Opening: Ø 15
Material	Recycled Solid Steel Bar
Finish	Hot Dip Galvanized with RAL 9007 Gray Aluminum Powdercoat
Installation	Mount to Boulevard Tree Grate per Manufacturer specifications with corrosion-resistant hardware.
Manufacturer	Victor Stanley
Paired With	Boulevard Tree Grate
Note	To be phased out



Soil Cells

RECOMMENDED OPTION

Silva Cell 2—by deeproot

Dimensions	24” W x 48” L Multiple Heights Available
Installation	Install to meet AASHTO H-20 loading requirements per Manufacturer-provided specifications. Seek manufacturer-assistance in individual project design & engineering.
Manufacturer	deeproot

RECOMMENDED OPTION

StrataVault 60 Series—by GreenBlue Urban

Dimensions	24” W x 24” L x 16” H
Installation	Install to meet AASHTO H-20 loading requirements per Manufacturer-provided specifications. Seek manufacturer-assistance in individual project design & engineering.
Manufacturer	GreenBlue Urban

ALTERNATE OPTION

StrataCell 60 Series—by GreenBlue Urban

Dimensions	20” W x 20” L x 10” H
Installation	Install to meet AASHTO H-20 loading requirements per Manufacturer-provided specifications. Seek manufacturer-assistance in individual project design & engineering.
Manufacturer	GreenBlue Urban

Bus Shelter

RECOMMENDED OPTION

Bus Shelter—by enseicom

Dimensions	149 ½" L x 84" W x 102 ¼" H 128" front opening
Material	Aluminum, tempered glass
Installation	Install per manufacturer's instructions
Manufacturer	enseicom
Reference	*Appendix section A-8* For elements to include in a Transit stop or shelter see *"Transit Shelters & Stops" on page 116*
Note	Tinting, etching, symbols, etc to make glass less transparent/increase visibility is encouraged. Custom bus stops and bus stop elements may be designed in consultation with the City and GMT.

Parking Meters

RECOMMENDED OPTION

Paystation Model CMTCCC Solar—by Cale

Multi Space Meter Installation

- See details for placement of pay station in *"Parking Meters & Kiosk" on page 114*
- Typically a concrete foundation for a pay station measures 2' × 2' × 2' which translates to @.29 yards of concrete X 4,000 # per yard would be 1,160 pounds of concrete. Spec was set up for anti theft.
- Also good in sandy soil around beach areas.
- Some have been installed at 18" deep which is @ 800 # of concrete which is probably more than enough in rock and clay.

Reference

Appendix section A-8

ALTERNATE OPTION

[Smart Meter] - Manufacturer

Meter Pole Installation

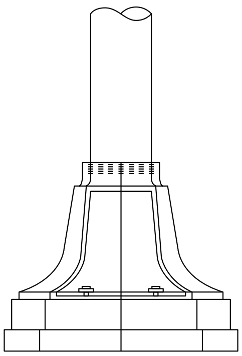
- Prefer to locate double meter head on a pole to serve two adjacent parking spaces.
- Meter pole in concrete sidewalk: core drill 4' diameter hole; set post 8" deep in non shrink construction grout.
- Meter pole in dirt: dig or auger post hole 18" deep and set in concrete, usually 80# per hole. Some sandy areas near the beach may require posts set 2' deep with plenty of concrete.
- Post height can vary from city to city. Normally 37" above grade. Handicap posts 28" to allow for 48" ADA visibility.
- Single post location usually 2' off curb and 3' back from head of space.
- May set closer to curb depending on 48' wide ADA clearance

Reference

Appendix section A-8

Traffic Control Signals

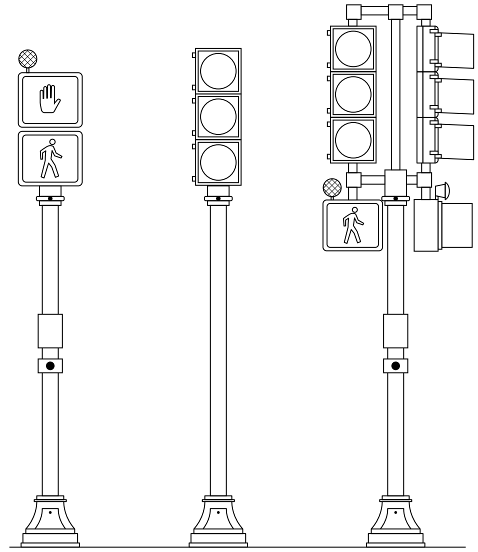
PEDESTAL POST AND BASE



Description:	Octagonal base
Dimensions:	Base: 16″–18″ W typ.; 14″ H typ. Post: 4½″ diameter Hand hole: 60 sq. in. (min.)
Color:	Black
Footing Detail:	See "Details of Reinforced Concrete Footing for Pedestal Post" in ref. dwg. **VTrans Standard E-170** in *Appendix section A-4*
Reference:	See ref. dwg. **VTrans Standard E-170 Traffic Control Signals Pedestal Post Mounted** in *Appendix section A-4*

Note: These standards provide details for traffic control elements for which the City may indicate preference; it is not inclusive of all traffic control devices which may be placed within the downtown public rights of way. This document is not intended to replace the MUTCD. A traffic control device not included in this document should not be assumed to be procluded from use within the downtown if the appropriate traffic characteristics warrant its use. Professionals should consult the appropriate MUTCD standards that apply to any proposed traffic control devices, including but not limited to those which are referenced herein.

PEDESTAL POLE



Description:	Left: Pedestrian signal Center: Vehicle signal Right: Vehicle and Pedestrian signals
Setback:	2' min. from face of curb (see ref. dwg. **VTrans Standard E-171A** in *Appendix section A-4*)
Audio Signal:	8' min. mounting height
Pedestrian Push Button:	When a pedestrian push button is used, include auditory features that announce "Wait" when button is engaged, and which verbally indicates which leg of an intersection may be crossed. Follow all applicable MUTCD standards for the mounting location, accessibility and signage. 3'-6" mounting height from sidewalk surface. See ref. dwg. **VTrans Standard E-170 Traffic Control Signals Pedestal Post Mounted** in *Appendix section 313* Accessibility Detail: **VTrans ref. dwg. Standard E-171C** in *Appendix section A-4*
Color:	Black
Note	Must be able to accomodate street light mounted to top of pole As Great Streets Standards are implemented and pedestrian crossing distances become shorter, some downtown signals may transition to include an automatic pedestrian phase. Some signals may be accompanied by lights, signals and/or signage that provide additional visibility and protection for pedestrians. When these devices are used, they must conform to applicable MUTCD standards.

Signage

INFORMATION & DIRECTIONAL SIGNAGE

Pedestrian-oriented signs have been developed for downtown to assist visitors and residents. Examples of key destinations to include in signage and/or to locate signage are libraries, post offices, government offices, transit centers, schools, museums, entertainment centers, shopping districts, parks, public rest rooms, and tourist attractions.

Because pedestrians and bicyclists expend their own energy getting to a destination, it is important to maximize wayfinding opportunities to reduce the possibility of out of direction travel. In addition, destinations that are familiar to a resident may be unknown to a visitor. Frequently spaced information kiosks and directional signs can alleviate these problems and make the environment more inviting to walking and bicycling. Where provided, locate information kiosks and directional signs adjacent to but outside the Pedestrian Through Zone.

Place only enough signs to lead a pedestrian confidently to the destination by the best route. Avoid adding clutter to the streetscape by clustering signs in strategic locations on a single post where possible.

Additional Resources

VTrans Standard E-121 Standard Sign Placement Conventional Road in *Appendix section A-9*

VTrans Standard E-125 Travel Information Council Signs in *Appendix section A-9*

VTrans Standard E-161 W-Shaped Steel Sign Post in *Appendix section A-9*

VTrans Standard E-162 Tubular Aluminum Sign Post in *Appendix section A-9*

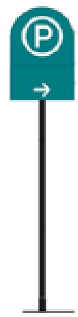
VTrans Standard E-163 Tubular Steel Sign Post in *Appendix section A-9*

VTrans Standard T-56 Standard Sign Placement in *Appendix section A-9*

Lake Champlain Wayside Exhibit Manual in *Appendix section A-9*

Vermont Roadside Historic Site Markers in *Appendix section A-9*

Wayfinding



Hairpin Directional Signs

Dimensions	12' H x 3'-1" W x 3" D
Material	3" curved aluminum pipe .10" aluminum panels
Reference	See **Burlington Wayfinding Improvements Plans—STP5000(17)** in *Appendix section A-9*

Small Directional Signs (Parking)

Dimensions	Total post height and clearance based on panels/ messages. Min. 5'-0"; min. clearance 7'-0" where pedestrian and/or turning movements occur below sign Panel width: 1'-6"
Material	2" square 14 gauge pre-drilled "off-the-shelf" aluminum post. .10" aluminum panel
Reference	See **Burlington Wayfinding Improvements Plans—STP5000(17)** in *Appendix section A-9*

Pedestrian Wayfinding

Dimensions	Total post height varies. Typical clearance 8'-0". Panels: 6" H x 1'-9" (1'-7½" visible) W
Material	4" circular aluminum post ¼" aluminum panel
Reference	See **Burlington Wayfinding Improvements Plans—STP5000(17)** in *Appendix section A-9*

Public & Event Information

Map & Public Information Kiosk (PILOT)

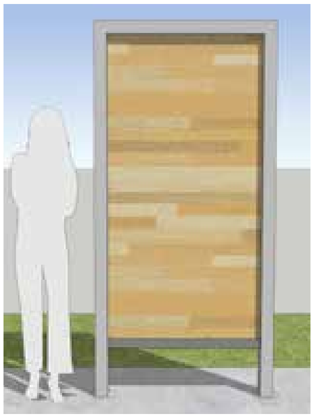
The City is developing a pilot prototype for a map kiosk intended to display information beneficial to those who are walking, biking, and using public transit. The information is likely to include a map with information about walking distances, key destinations, bike facilities, and transit facilities and operations. The kiosk design should be of the highest quality and in coordination with the overall city-wide wayfinding program. Once developed and approved, the kiosk design will become part of the Downtown Street Design Standards.

Dimensions	Approx. 7' high x 1.5' wide x 10" deep Kiosk may have one or two faces, depending on the final design and location
Material	Frame should be aluminum or stainless steel with tempered glass or some other material insert to display content.
Installation	Unit shall be bolted to the sidewalk or concrete pad.
Location	Map and wayfinding information most useful near intersections. See *"Kiosks (Map, Information & Bulletin Board)" on page 113* for more information regarding placement within the public right-of-way
Notes	The City may consider whether internally illuminated wayfinding information could be incorporated as part of these kiosks.

Curated Event & Information Kiosk (PILOT)

The City is developing a pilot prototype for a curated information and event kiosk intended to display small or large posters for cultural events and other purposes. Once developed and approved, the kiosk design will become part of the Downtown Street Design Standards, and will installed at designated locations in downtown Burlington.

Dimensions	Approx 7' high x 3' wide x 1' deep A small overhang as part of the topmost part of the kiosk may be considered to help protect content from the elements. Kiosks may have one or two faces depending on the final design and location
Materials	Frame should be aluminum or stainless steel with tempered glass or some other material for affixing information.
Installation	Unit shall be bolted to the sidewalk or concrete pad.
Location	See *"Kiosks (Map, Information & Bulletin Board)" on page 113* for more information regarding placement within the public right-of-way
Notes	The City may consider whether a backlit or front lit kiosk is appropriate for increasing visibility at night.



Public Bulletin Board (PILOT)

The City is developing a pilot prototype for a public bulletin board intended to display small posters and advertisements for cultural events in the community. This bulletin board is intended to be designed using similar materials and design aesthetic as the Kioks, but utilize materials that are more accessible for public use. Once developed and approved, the bulletin board design will become part of the Downtown Street Design Standards, and will installed at designated locations in downtown Burlington.

Dimensions	Approx 7' H x 3' W x 4" D A small overhang as part of the topmost part of the bulletin board may be considered to help protect content from the elements. Kiosks may have one or two faces depending on the final design and location.
Materials	Frame should be aluminum or stainless steel with plywood or some other material for affixing information via stapling.
Installation	**Unit shall be bolted to the sidewalk or concrete pad.**
Location	See *"Kiosks (Map, Information & Bulletin Board)" on page 113* for more information regarding placement within the public right-of-way


Waterfront
.50 mi
Campus District
.58 mi
Restrooms
Toilettes
In City Hall
Bus Station